

Student: \_\_\_\_\_

Date: \_\_\_\_\_

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## KNOTS DIAGNOSTIC EXAM

Time limit = 1 hour 30 min

This exam is designed to identify any gaps that may exist in your knowledge. It is designed to apply to all forms of roped activities that involve risk of falls from height. Missed exam questions may indicate that you require specific training to address any identified gaps in your knowledge. Poor performance indicates that you are not yet ready to earn a qualification. Each missed exam question must be thoroughly reviewed until competency is achieved.

Carefully read each question then choose the *most* correct answer. This exam should be completed without the assistance or advice of others. You may refer to your own notes.

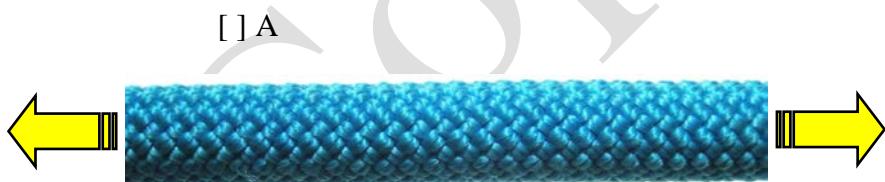
**NOTE:** The tail lengths of knots in this paper are deliberately tied short to ensure the full image would fit within the macro field-of-view of the camera lens. Assume all tail lengths are set to minimum safe lengths when answering questions. Most knots are shown loosely dressed to allow structural details to be observed.

**Competency can be demonstrated by initially scoring 100%**

Q1. All knots have certain attributes. Some attributes are more important than others. Choose the response that you believe contains the most important attribute (or combination of attributes).

- a) Strength
- b) Security
- c) Stability
- d) Suitability
- e) A combination of suitability and strength
- f) A combination of security and stability
- g) None of the above are correct

Q2. Study the photos carefully. Which photo indicates the higher rope breaking strength; A or B? You will need to explain your answer...



Explain your answer:

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Q3. Study the photos carefully. All knot structures can be classified into 3 distinct categories as follows:

1. Knot
2. Hitch
3. Bend

Draw a line to link each image that corresponds to its correct descriptor in the text box.



**A**

**1. KNOT**



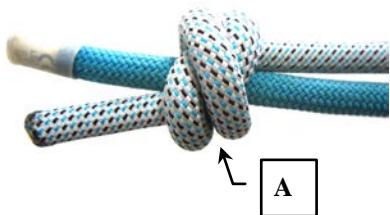
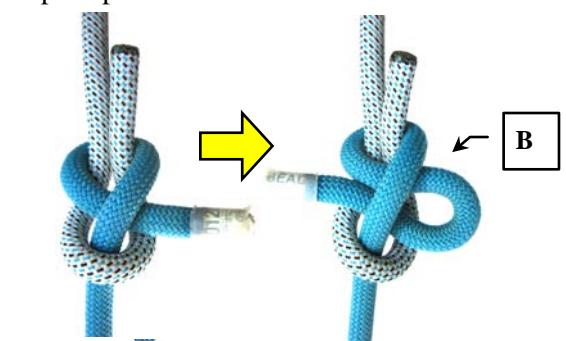
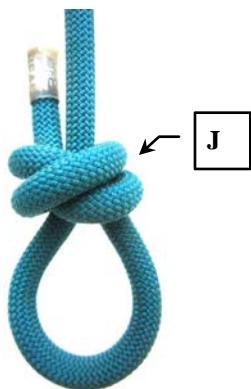
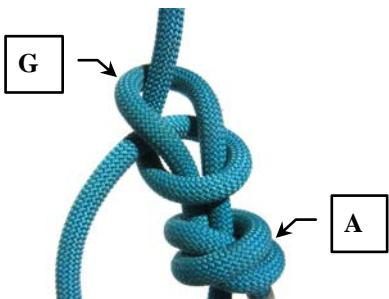
**B**

**2. BEND**

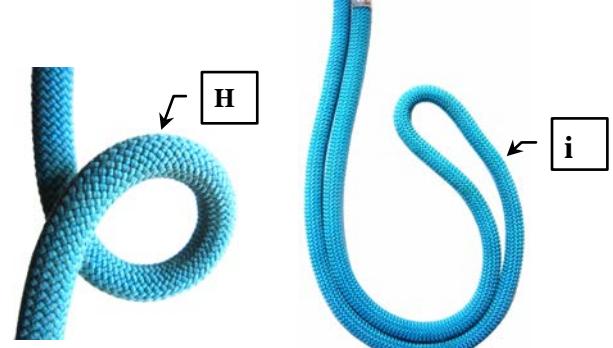
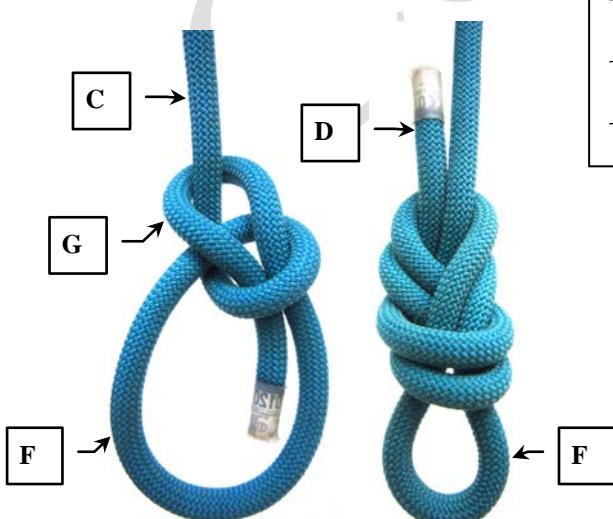
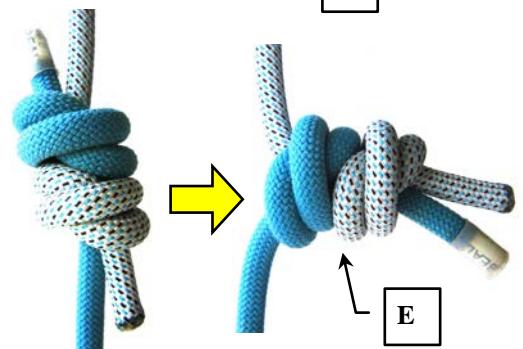
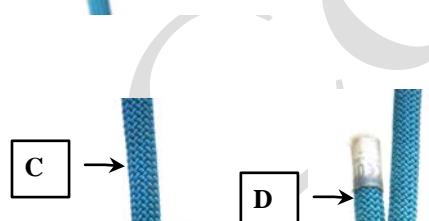
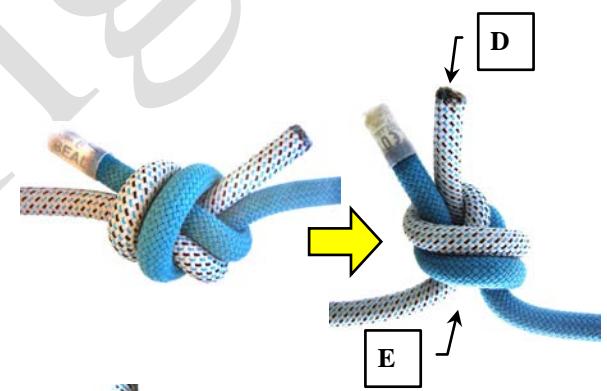
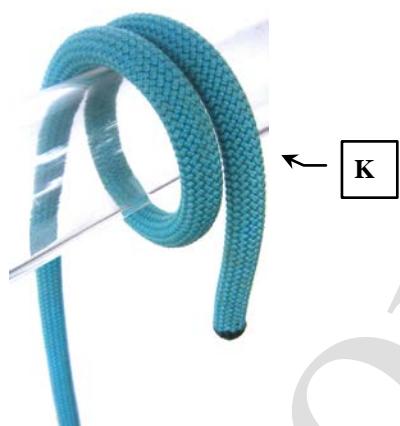


**C**

Q4. Study the photos carefully. From the list provided, match the most correct descriptor with the letter of the alphabet. Write the letter of the alphabet in the space provided to match the descriptor.



- |                          |               |
|--------------------------|---------------|
| <input type="checkbox"/> | Turn (540°)   |
| <input type="checkbox"/> | Noose         |
| <input type="checkbox"/> | Tail          |
| <input type="checkbox"/> | Strangle      |
| <input type="checkbox"/> | Collar        |
| <input type="checkbox"/> | Eye           |
| <input type="checkbox"/> | Slipped       |
| <input type="checkbox"/> | Bight         |
| <input type="checkbox"/> | Offset        |
| <input type="checkbox"/> | Wraps         |
| <input type="checkbox"/> | Part          |
| <input type="checkbox"/> | Loop          |
| <input type="checkbox"/> | Standing Part |



Q5. Study the photos carefully. Name each category of knots.

Category 1: \_\_\_\_\_

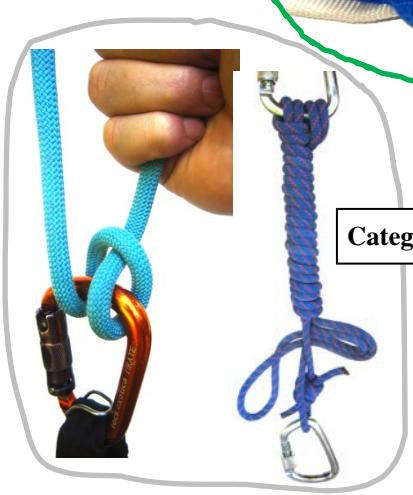
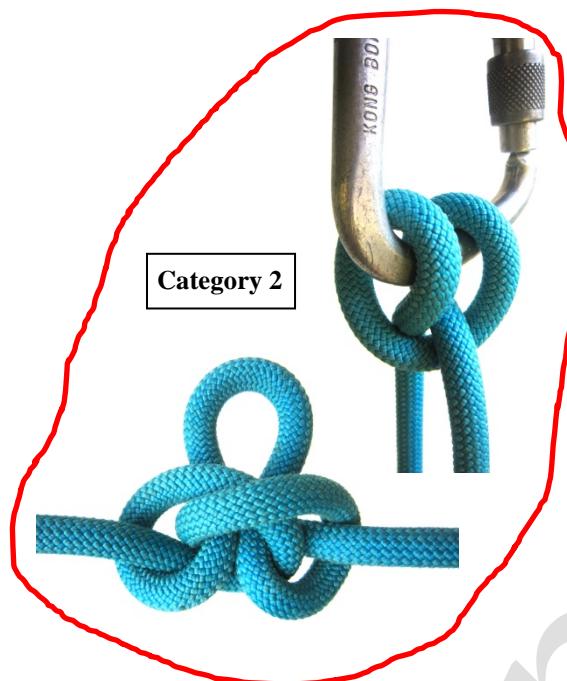
Category 2: \_\_\_\_\_

Category 3: \_\_\_\_\_

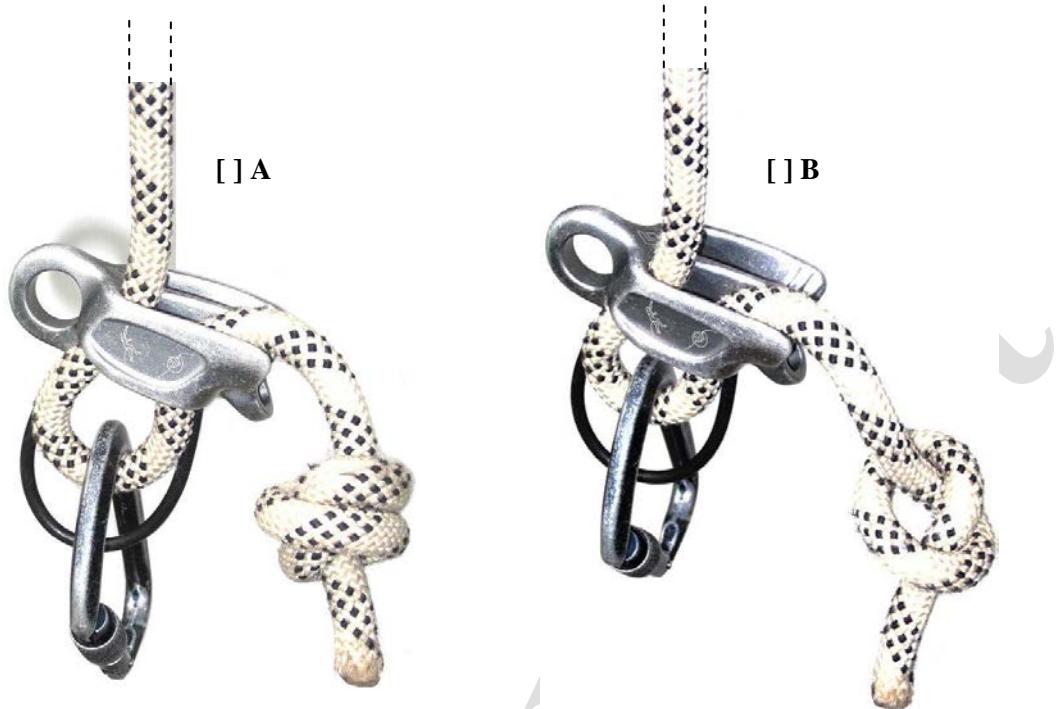
Category 4: \_\_\_\_\_

Category 5: \_\_\_\_\_

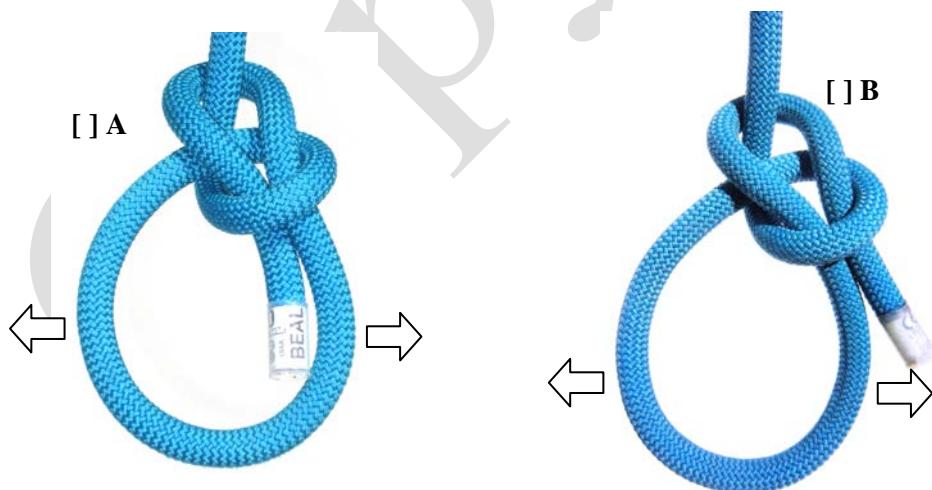
Category 6: \_\_\_\_\_



- Q6. Study the photos carefully. Choose the stopper knot you believe will be most effective in preventing accidental disconnection of the rope from the belay device. You will be required to explain your answer.

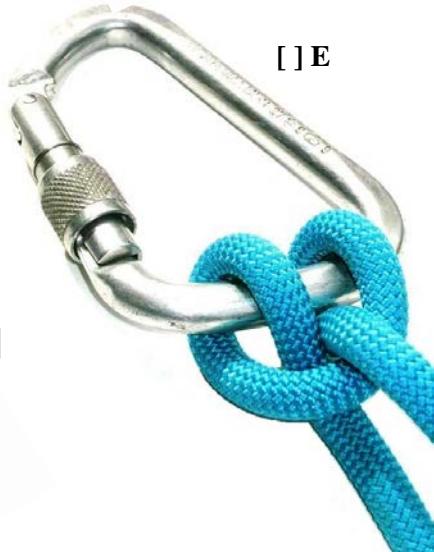


- Q7. Study the Bowline photos carefully. Choose the knot structure you believe is most vulnerable to circumferential (ie hoop or ring) loading. You will be required to explain your answer.  
Note: Arrows indicate direction of loading



Explain your answer: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Q8. Study the photos carefully. Only one of the photos indicates the correct form and geometry for a Clove hitch. Choose the photo you believe indicates the correct geometry for a Clove hitch.



8.1 What is this structure called a Clove hitch rather than Clove knot?

8.2 What category does this knot best belong to?

- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

8.3 Describe at least one (1) application for this knot:

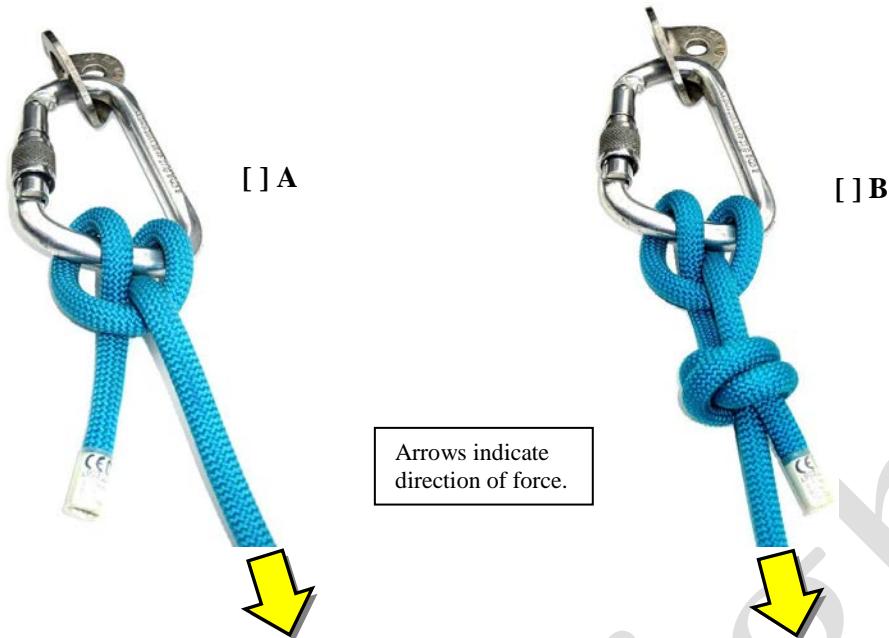
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8.4 This question relates to the photo you chose as the correct form/structure.

Indicate with an arrow the part of rope you believe should be the *primary load strand*.

Q9. Study the photos carefully. You have decided to tie a Clove hitch close to the tail end of your rope. Which photo indicates the correct procedure?

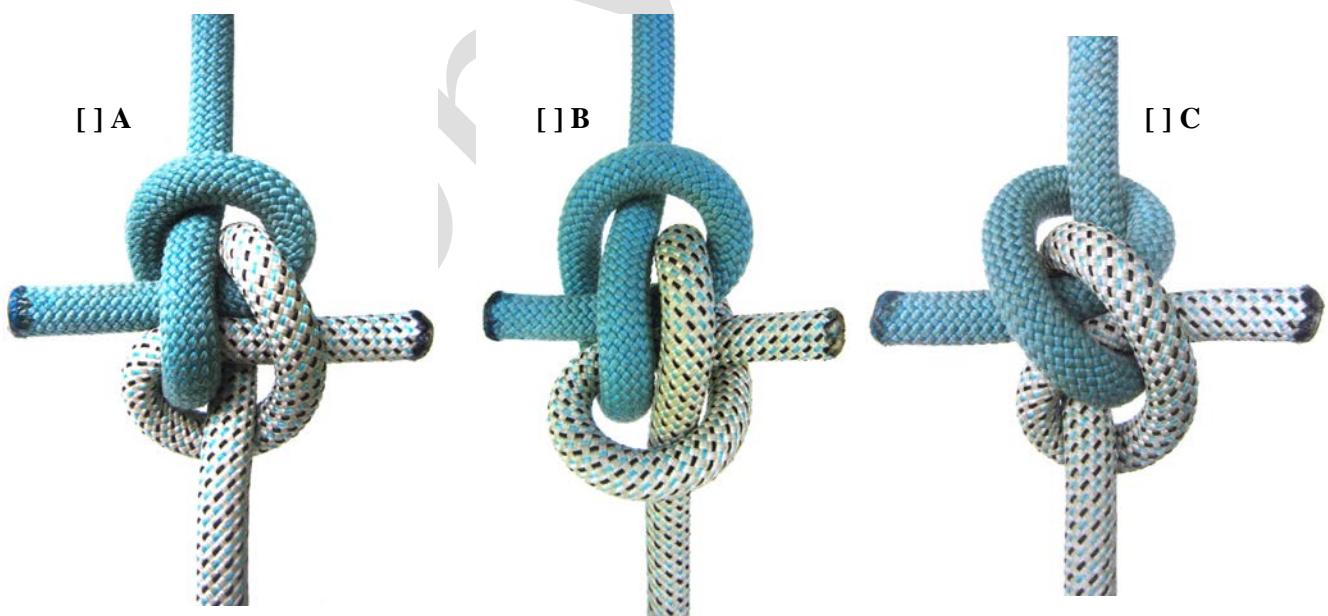


Explain your answer:

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Q10. Study the photos carefully. Select the knot you believe is the Zeppelin bend.



Explain your answer:

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- Q11. Study the photos carefully. This question is about the Figure 8 eye knot. Only one of the photos indicates the correct form and geometry for a Figure 8 eye knot. Choose the photo you believe indicates the correct form.

[ ] A



11.1 What category does this knot best belong to?

- [ ] fixed eye/loop
- [ ] termination
- [ ] mid-line (TIB)
- [ ] end-to-end joining
- [ ] slide and grip
- [ ] releasable load control

11.2 Describe at least one (1) application for this knot:

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[ ] B



11.3 This knot is widely used around the world and is popular with climbers. Provide a rationale as to why this particular knot is popular (explain).

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[ ] C



11.4 In terms of knot security, what is the minimum safe tail length for this type of knot?

- [ ] a. 50mm
- [ ] b. 100mm
- [ ] c. 100mm if the knot is classified as 'inherently secure', otherwise 200mm
- [ ] d. 200mm
- [ ] e. 300mm
- [ ] f. It can be any length (it doesn't matter)
- [ ] g. None of the above are correct

[ ] D

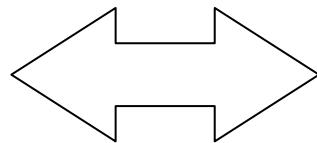


- Q12. Study the photos carefully. There are two image paths, each ending up in a particular finished form. Is the end result the same knot or, are they two different knots?

Write your answer in the text box below. You will be required to explain your answer.



A



B



*Are these two structures the same knot, or are they different knots?*

They are *different* knots

They are the *same* knot

A. What is the name of this knot?

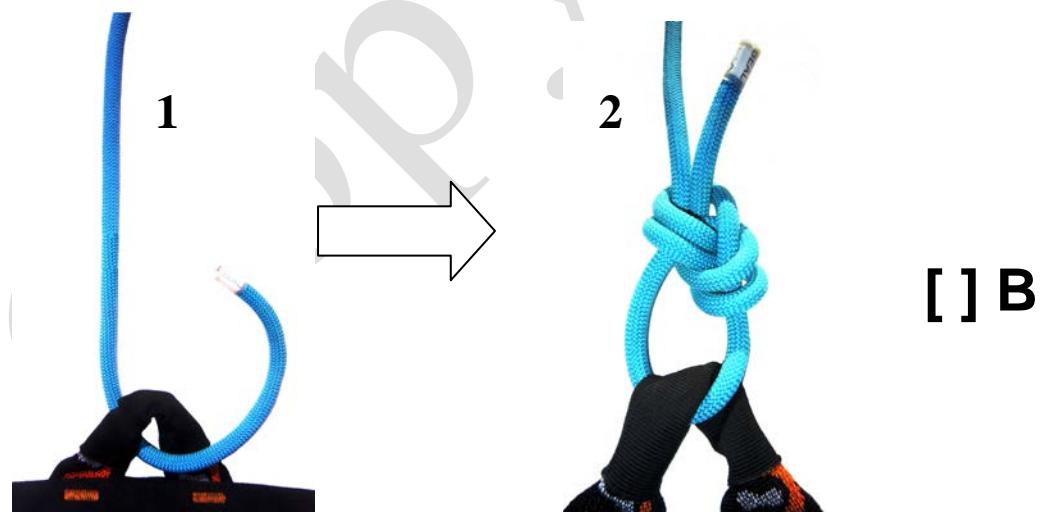
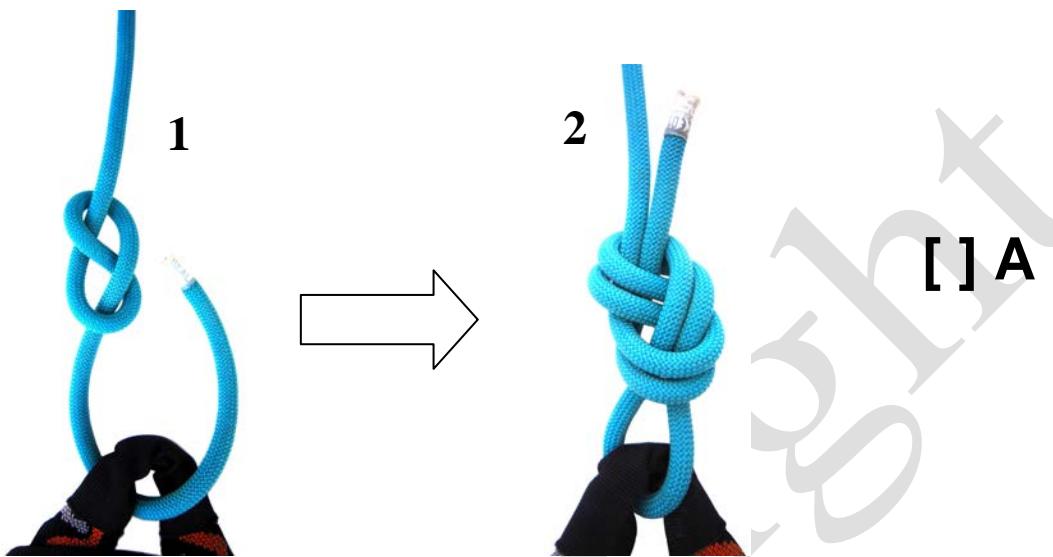
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B. What is the name of this knot?

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- Q13. Study the photos carefully. There are two image paths ('A' and 'B'), each ending up with the rope tied directly into a harness. Assume that both rope tie-in knots are equally valid. However, there are significant differences in the way each knot is tied.

One of the knots is Post Eye Tiable (PET). Indicate which of the knot tie-in methods is 'PET'. Explain what is meant by 'PET'. Are there any advantages/disadvantages with 'PET' knots? Explain your answer below...



Explain your answer: (What does 'PET' mean? Describe advantages/disadvantages of a PET knot):

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- Q14. Study the photos carefully. Only one of the photos indicates the correct form and geometry for a particular type of knot. Choose the photo you believe indicates the correct form.  
Note: Answer all of the questions in the text boxes...

[ ] A



14.1 What is the name of this knot?

14.2 What category does this knot best belong to?

- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

14.3 Describe at least one (1) application for this knot:

[ ] B



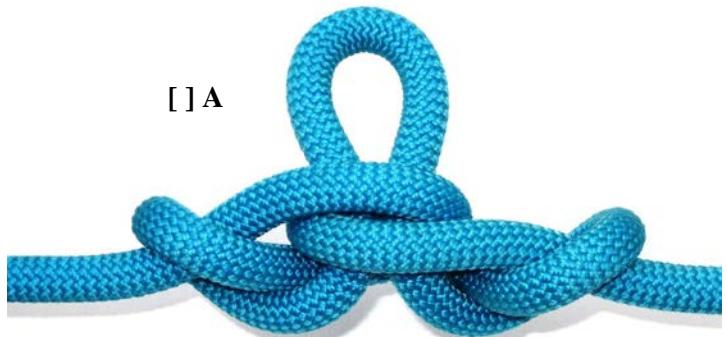
14.4 This structure is one of the most secure and stable knots known. However, it has one significant **disadvantage**... what is that disadvantage?

[ ] C



Q15. Study the photos carefully. Only one of the photos indicates the correct form and geometry for a particular type of knot. Choose the photo you believe indicates the correct form.

[ ] A



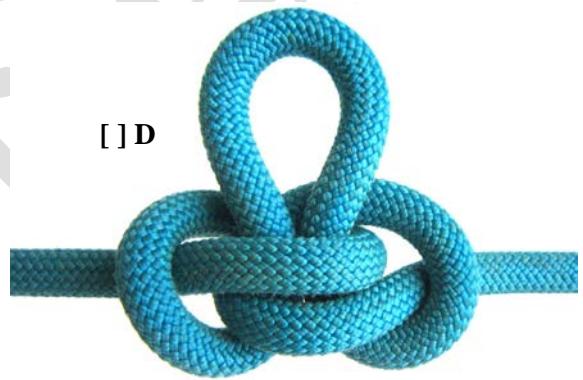
[ ] B



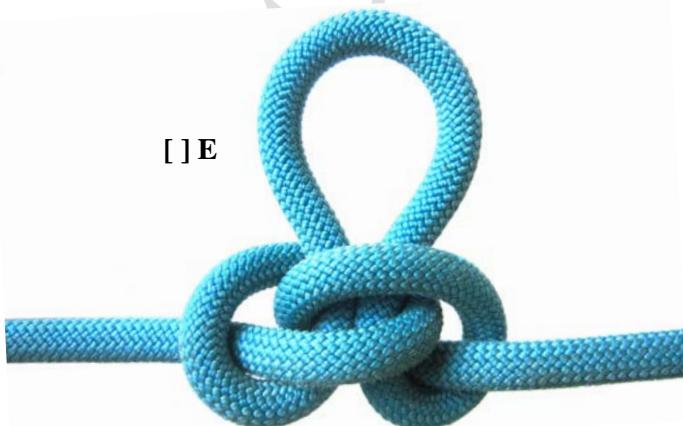
[ ] C



[ ] D



[ ] E



15.1 What is the name of this knot?

15.2 What category does this knot best belong to?

- [ ] fixed eye/loop
- [ ] termination
- [ ] mid-line (TIB)
- [ ] end-to-end joining
- [ ] slide and grip
- [ ] releasable load control

15.3 Describe at least one (1) application for this knot:

Q16. Study the photos carefully. Only one of the photos indicates the correct form and geometry for a particular type of knot. Choose the photo you believe indicates the correct form.

[ ] A



16.1 What is the name of this knot?

16.2 What category does this knot best belong to?

- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

[ ] B



16.3 Describe at least one (1) application for this knot:

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[ ] C



16.4 Is tail length important when this knot is tied in webbing?

- No
- Yes

Explain:

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- Q17. Study the photos carefully, then answer each of the questions where indicated. Which of the photos indicates the correct form/geometry of the knot/hitch? You will be required to explain your answer...

To climber



**A [ ]**

To climber



**B [ ]**

To climber



**C [ ]**

To climber



**D [ ]**

Explain your answer:

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- 17.1 What is the name of the knot/hitch shown in the photos?
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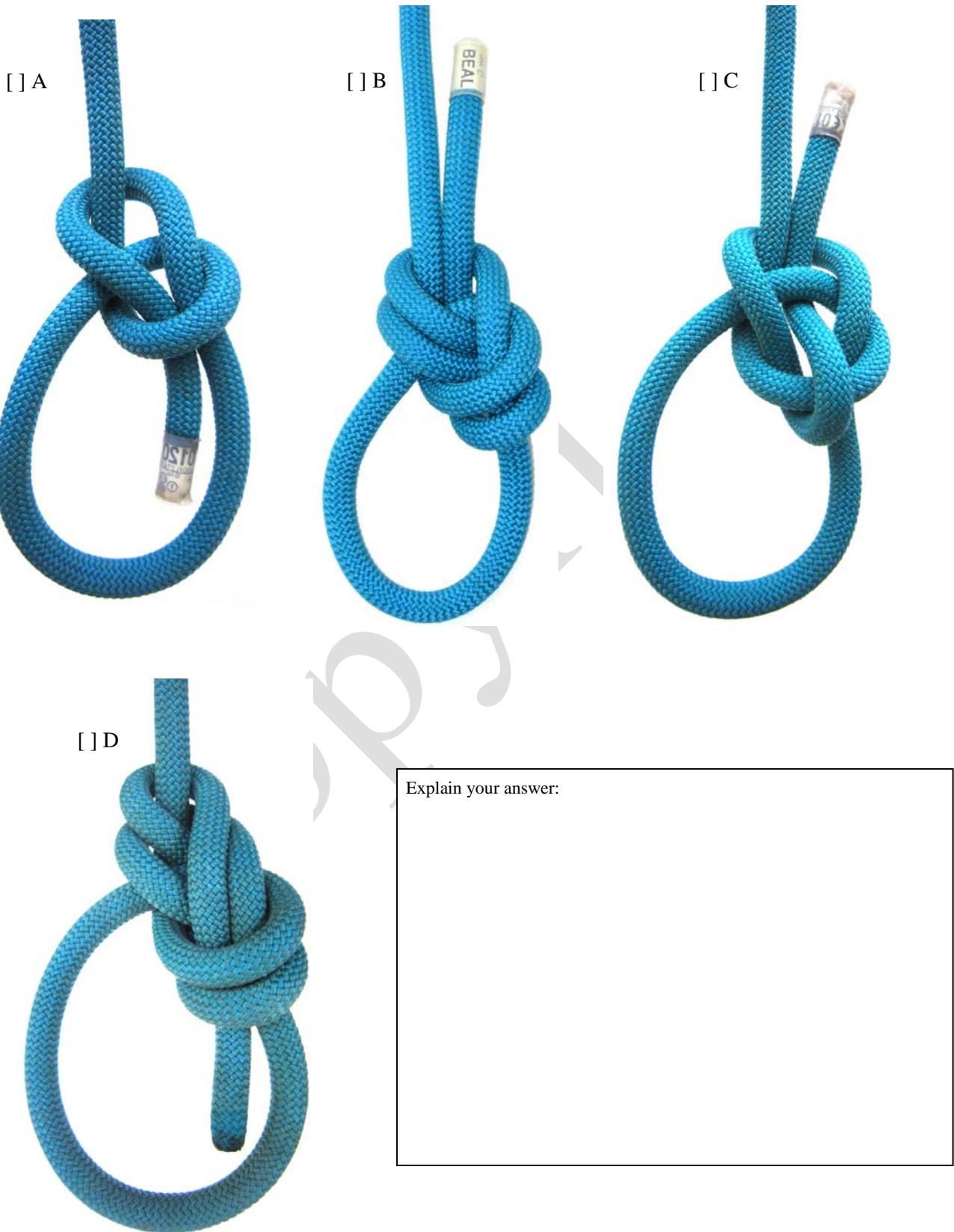
- 17.2 What category does this knot/hitch best belong to?

- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

- 17.3 Describe at least two (2) different applications for this knot/hitch:

- i) \_\_\_\_\_
- ii) \_\_\_\_\_

Q18. Study the photos carefully. Each photo shows a different type of Bowline (there are many different Bowlines). Choose the structure you believe is **unsafe** (because it's not secure and it's unstable) for life critical applications (eg climbing). There is only one correct answer. You will be asked to explain your reasoning including why you think the other knot structures are safe (ie stable and secure). NOTE: All knots are shown loosely tied with short tails for clarity.



Q19. Study the photo carefully, and then answer the questions in the box below.



19.1 What is the name of this knot?

\_\_\_\_\_

19.2 What category does this knot best belong to?

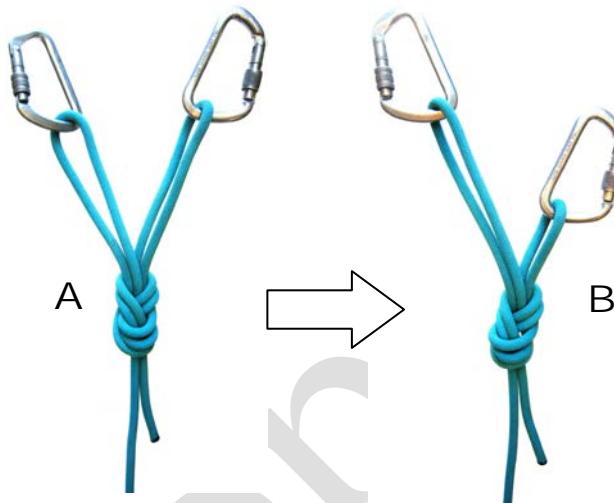
- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

19.3 Describe an application for this knot...

\_\_\_\_\_

\_\_\_\_\_

Q20. Study the photos carefully. To advance from 'A' to 'B', can this be achieved *without untying the knot*? Indicate your answer in the box provided...



[ ] a

**No:** You have to untie the knot to adjust the size of each eye leg. When making adjustments to one eye leg, it doesn't affect the other leg.

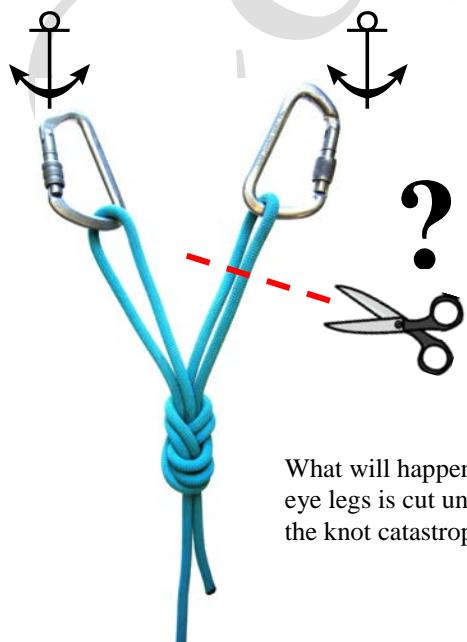
[ ] b

**Yes:** You can adjust each eye leg without untying the knot. Any adjustment made to one eye leg has a corresponding *opposite* effect to the other leg.

[ ] c

**None of the above:** This knot can't be adjusted because it would alter the structure and make it vulnerable to slipping.

Q21. Study the photo carefully. What will happen if one of the eye legs is cut under load? Will the knot catastrophically fail? Indicate your answer in the text box.



[ ] a

If one of the eye legs is cut, the knot will catastrophically fail

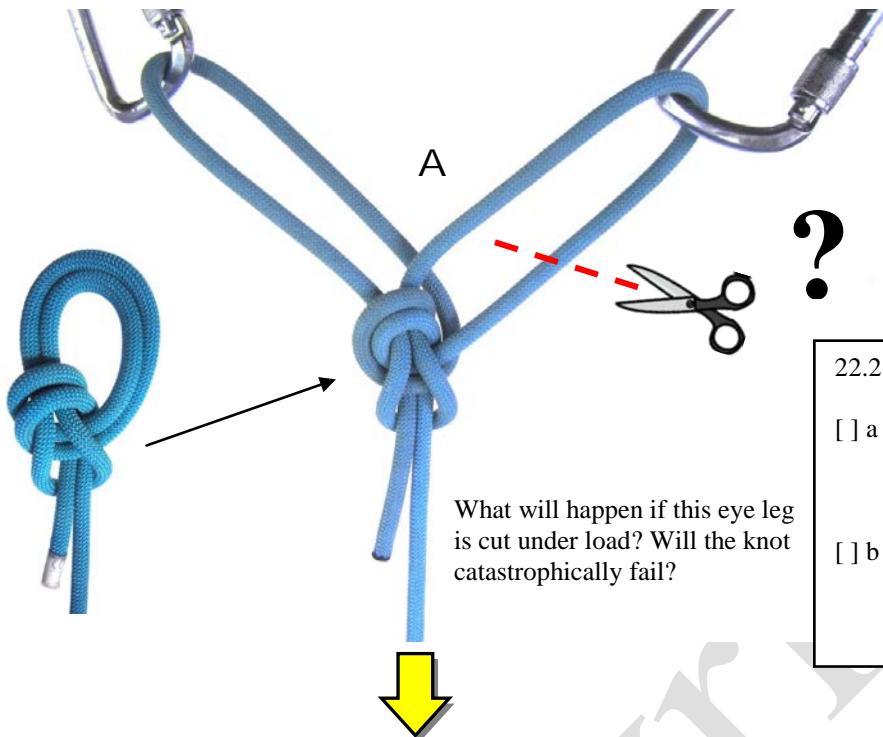
[ ] b

Nothing will happen. The core of the knot will remain secure due to internal friction and compression.

What will happen if one of the eye legs is cut under load? Will the knot catastrophically fail?

Q22. Study the photos carefully. This question relates to Q21, and depicts a load sharing anchor system. In system 'A', one of the eye legs is cut. In system 'B', the opposite leg is cut.

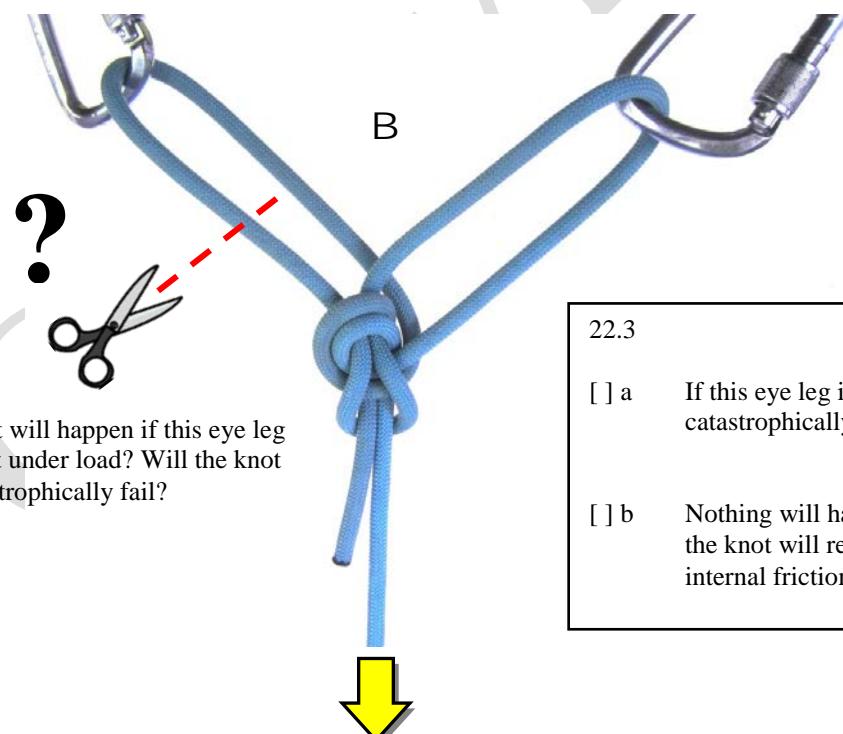
22.1 What is the name of the knot used in this system? \_\_\_\_\_



What will happen if this eye leg is cut under load? Will the knot catastrophically fail?

22.2

- [ ] a If this eye leg is cut, the knot will catastrophically fail.
- [ ] b Nothing will happen. The core of the knot will remain secure due to internal friction and compression.



What will happen if this eye leg is cut under load? Will the knot catastrophically fail?

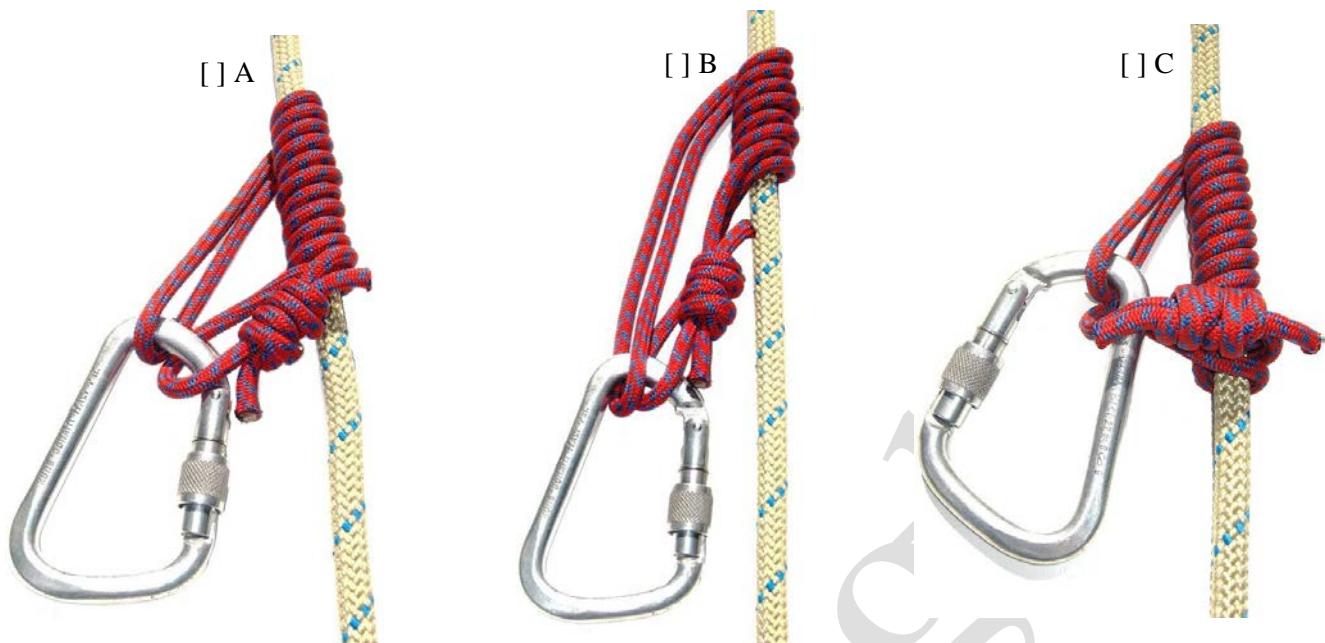
22.3

- [ ] a If this eye leg is cut, the knot will catastrophically fail.
- [ ] b Nothing will happen. The core of the knot will remain secure due to internal friction and compression.

22.4 Are there any advantages of this particular knot in contrast to the knot used in Q21?

Explain: \_\_\_\_\_  
\_\_\_\_\_

Q23. Study the photos carefully. Only one of the photos indicates the correct form and structure for a particular type of hitch. Choose the photo you believe indicates the correct form. You will be required to explain your answer.



23.1 Is this structure a ‘knot’ or a ‘hitch’? \_\_\_\_\_

23.2 What is the name of this knot/hitch? \_\_\_\_\_

23.3 What category does this knot/hitch best belong to?

- fixed eye/loop
- termination
- mid-line (TIB)
- end-to-end joining
- slide and grip
- releasable load control

23.4 Describe at least 2 applications for this type of knot/hitch:

i) \_\_\_\_\_

ii) \_\_\_\_\_

Q24. Study the photos carefully. There are two fundamental ways to tie a ‘Prusik hitch’. Why would a person choose to tie the hitch as per photo B? Are there any possible advantages for doing so? Are there any negative consequences?



Advantages:

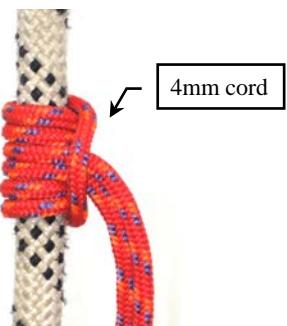
- 1.
- 2.
- 3.

Disadvantages:

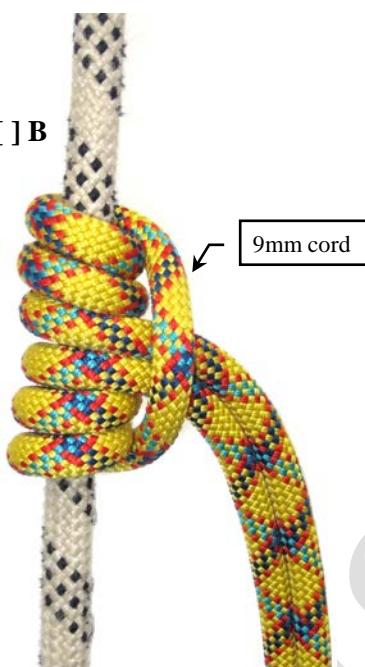
- 1.
- 2.
- 3.

Q25. Study the photos carefully. Each photo is illustrating the relationship of cord diameter to the host rope when using single prusik hitches. The host rope in each photo is 11mm in diameter. Choose the photo you believe indicates the most correct cord diameter to ensure secure grip when loaded cyclically and/or to re-grip from a loosened state. You will be required to explain your answer.

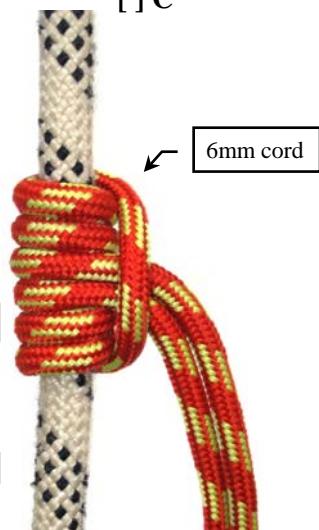
[ ] A



[ ] B



[ ] C



*Cord diameter is 36% of the parent rope.*

*Cord diameter is 81% of the parent rope.*

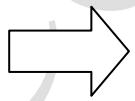
*Cord diameter is 54% of the parent rope.*

Q26. Study the photos carefully. The prusik hitch has been tied around both a single rope and double ropes. Will a prusik hitch still function as intended when formed around double ropes?

[ ] YES

[ ] NO

(You will be required to explain your answer...)



?



Explain...

- Q27. Study the photos carefully. Choose the photo you believe indicates the correct form. You will be required to explain your answer.



- Q28. Study the photos carefully. Which of these knots/hitches provides the *highest* relative grip on the host rope? You will be required to explain your answer...  
Note: Assume force is directed downwards...



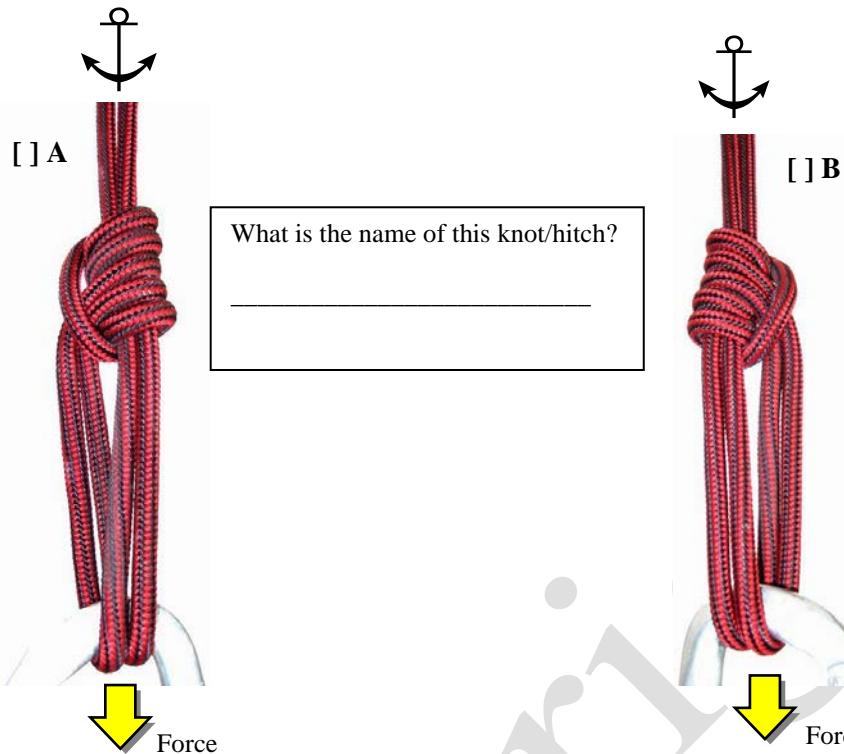
Explain your answer:

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- Q29. Study the photos carefully. Choose the photo you believe indicates the correct form/geometry. You will be required to explain your answer.



- Q30. Study the photos carefully. Some knots/hitches have certain limitations. What type of event would lead to catastrophic failure of the knot/hitch as depicted in the sequence of images below?



Explain your answer:

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- Q31. Study the photos carefully. If knot strength was an issue (eg a highline setup) choose the setup you believe will preserve the highest strength of the rope. What is the name of your selection? You will be required to explain your answer.

Name of knot/setup: \_\_\_\_\_

Explain your answer:  
\_\_\_\_\_  
\_\_\_\_\_

[ ] A



[ ] B



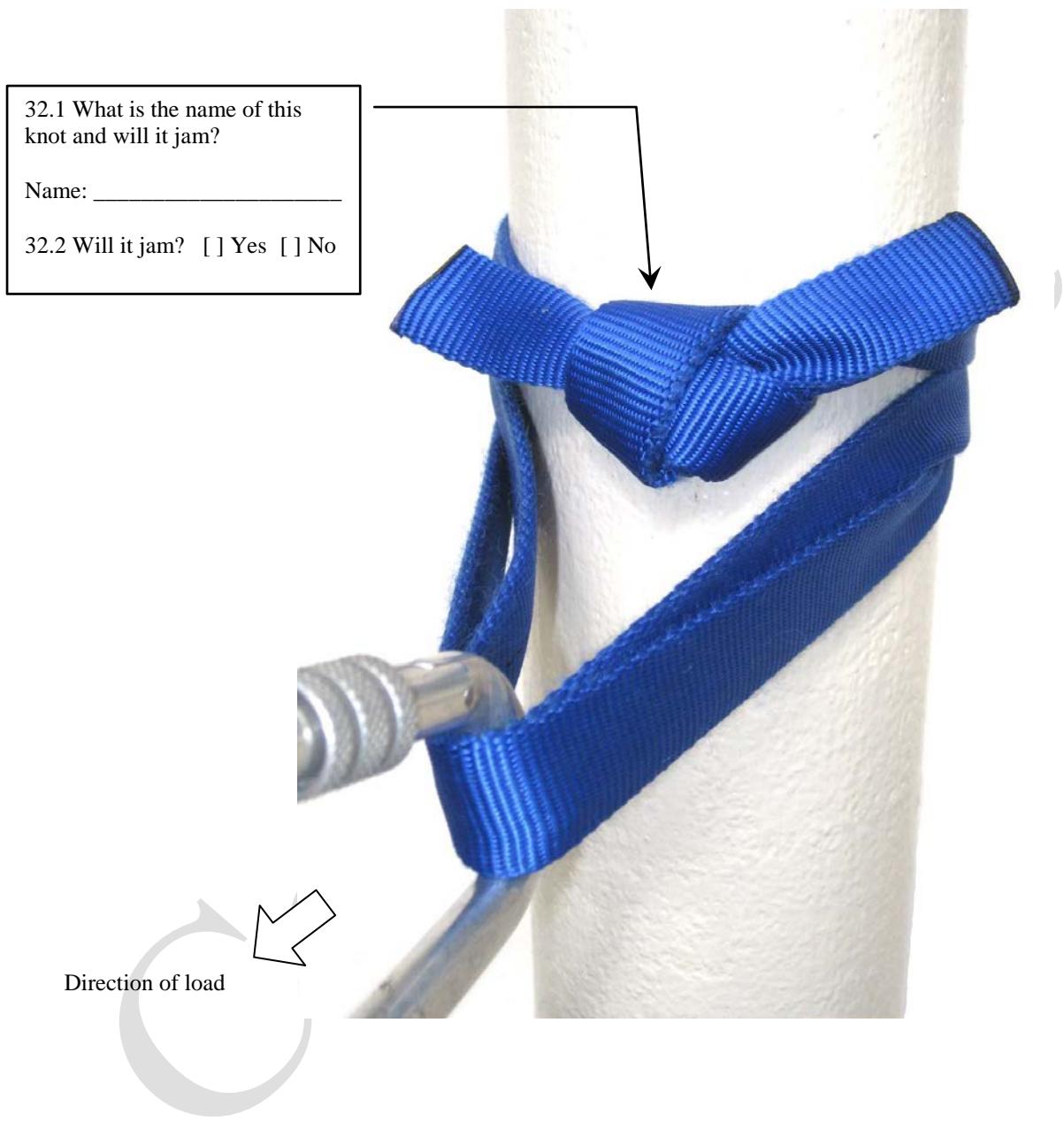
[ ] C



[ ] D



- Q32. Study the photo carefully. This particular knot configuration is used by many vertical rescue teams around the world. What are the principal benefits of using such a knot? Explain your answer below...

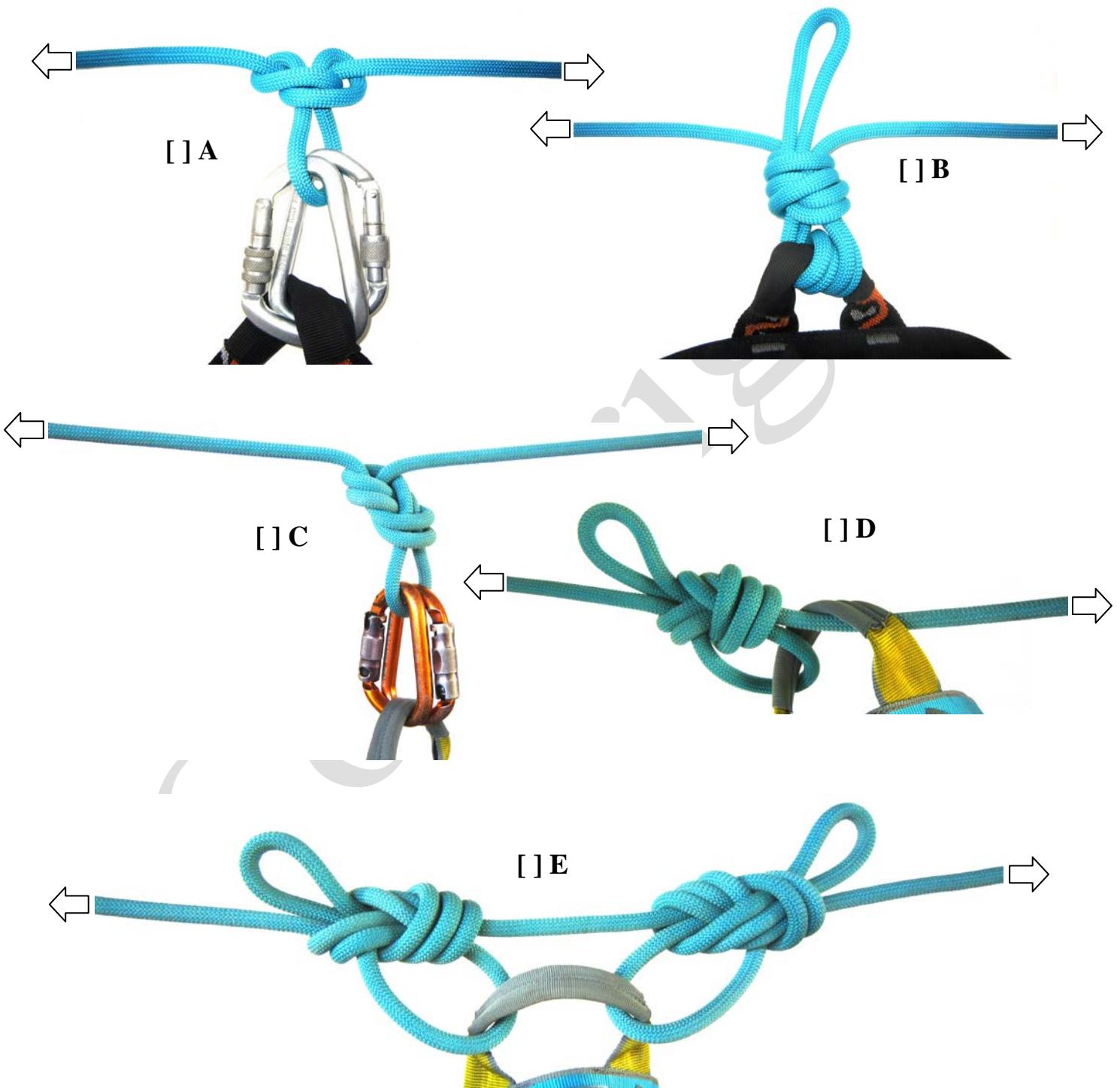


Explain the principal advantages of this knot configuration: (list as many as you can think of...)

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

- Q33. Study the photos carefully. You are the third member of a climbing team. You are required to ‘tie-in’ to the middle part of a rope using an appropriate knot. Choose the mid-rope ‘tie-in’ method that you believe is secure and most effective in different loading profiles.  
NOTE: ‘TIB’ means you do not have access to either end when ‘tying-in’!

You will be required to explain your answer.



Explain your answer: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- Q34. Study the photos carefully. Knots that are 'TIB' (Tiable In the Bight) are quite useful to climbers and roping technicians. Why is this so (explain)? Indicate which of the knots below are 'TIB' and define the concept of 'TIB'.

**A. TIB?**

- Yes  
 No



**B. TIB?**

- Yes  
 No



**C. TIB?**

- Yes  
 No



**D. TIB?**

- Yes  
 No



**E. TIB?**

- Yes  
 No



**F. TIB?**

- Yes  
 No



**G. TIB?**

- Yes  
 No



**H. TIB?**

- Yes  
 No



34.1 Explain why TIB knots are very useful to climbers and roping technicians:

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34.2 Provide a technical definition of 'TIB':

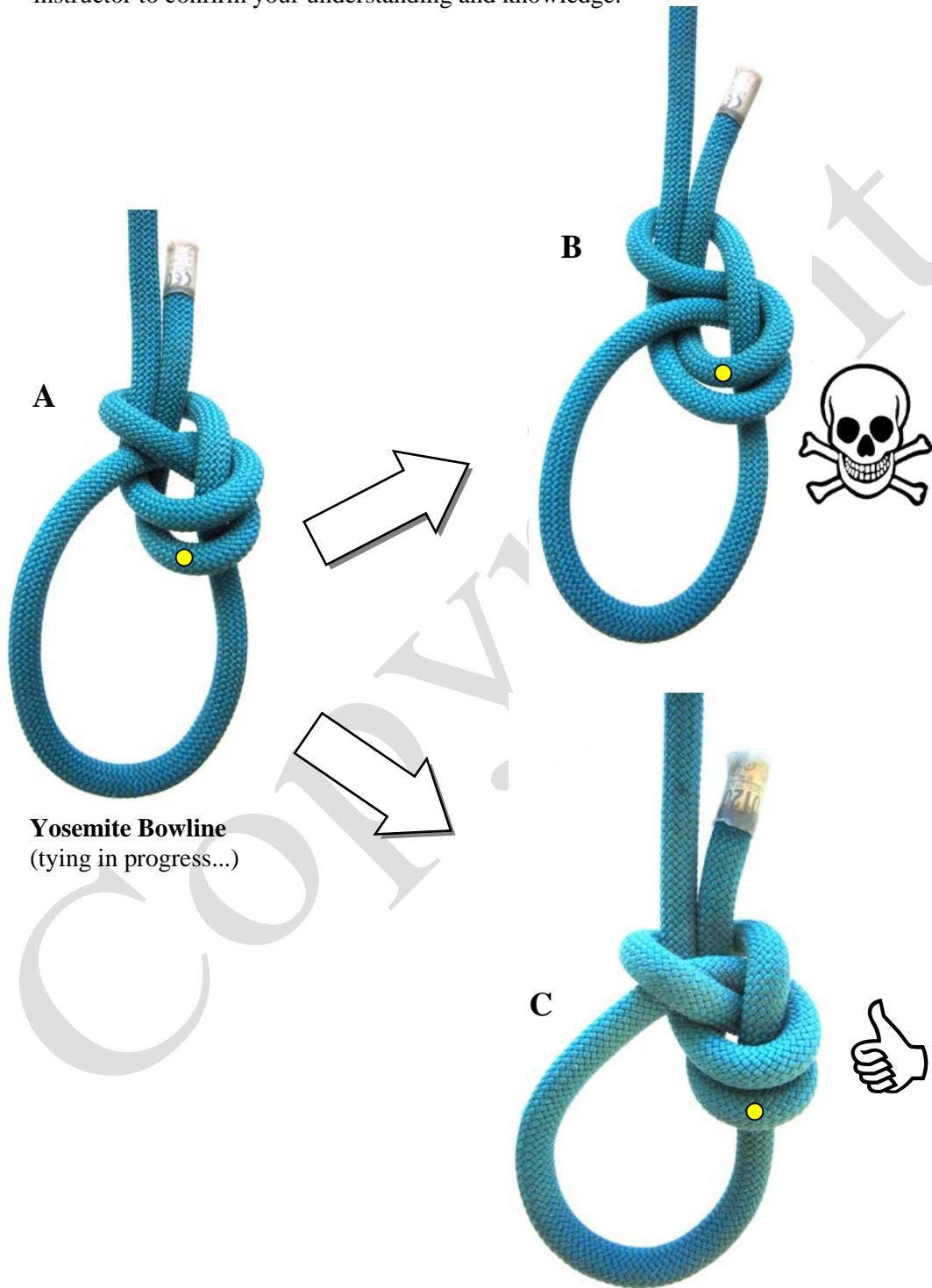
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- Q35. Study the photos carefully. The 'Yosemite Bowline' is shown loosely tied in image 'A'. There is a known vulnerability with this particular knot that could occur while dressing and setting of the structure. Photo 'B' shows a dangerous outcome when a segment of the knot has been *displaced*. Compare with photo 'C'.

Explain how this can occur. You will also be asked to demonstrate the 'failure mode' to your instructor to confirm your understanding and knowledge.



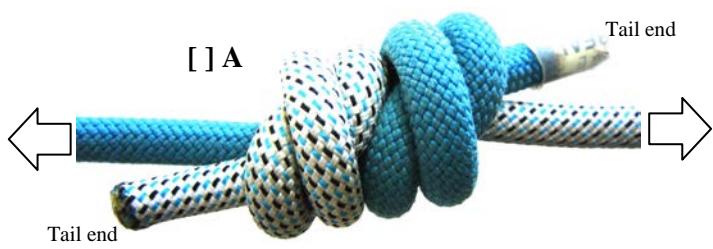
Explain how this can occur:

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- Q36. Study the photos carefully. You need to join your 2 ropes together in preparation for a long abseil descent (a retrievable abseil). Choose the knot you believe is stable, secure and will translate relatively easily around a 90 degree cliff edge (without getting stuck). You will be required to explain your answer. Note: All knots are shown with short tails for clarity.



Explain...



[ ] C



[ ] D



Tail ends



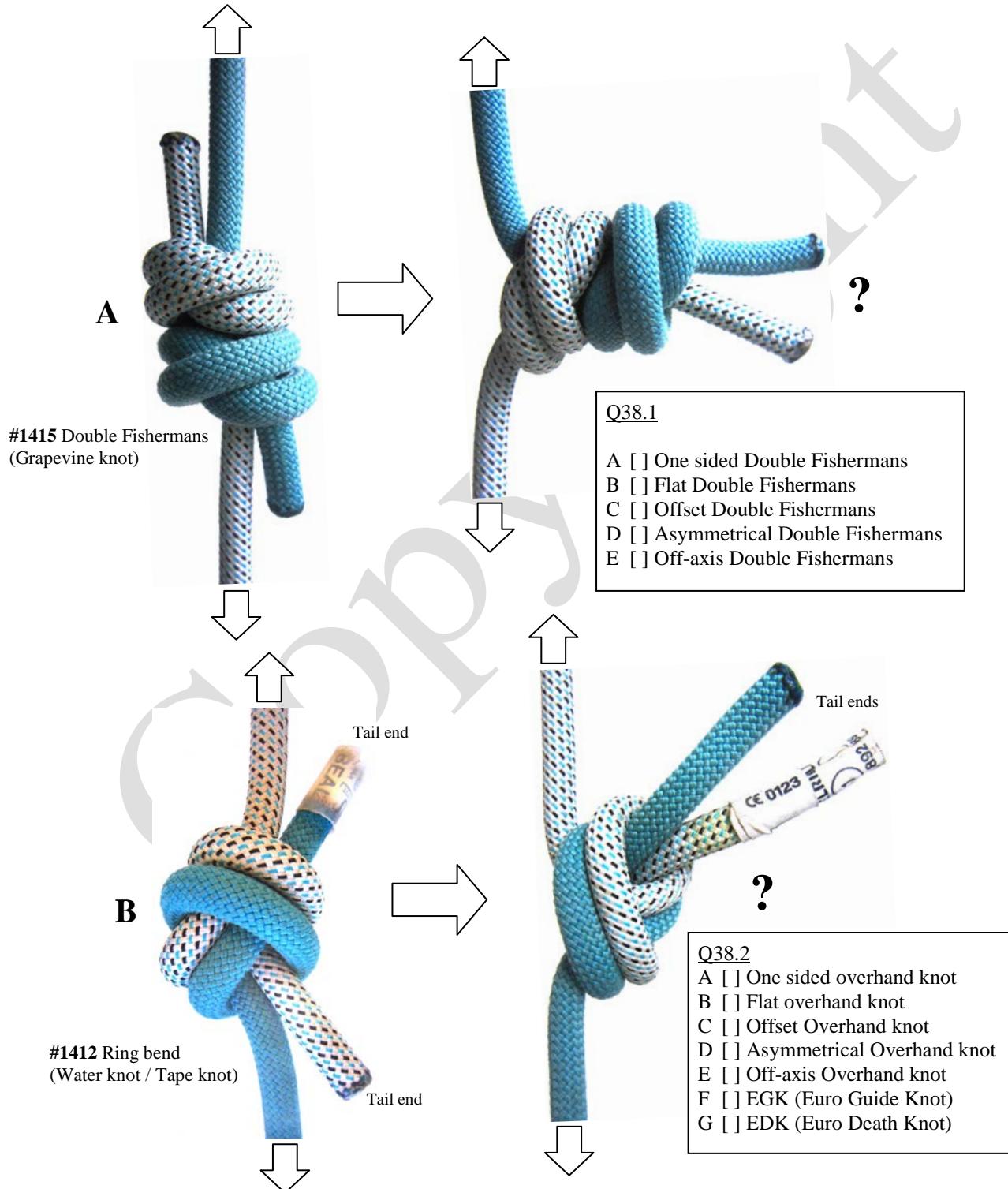
[ ] G



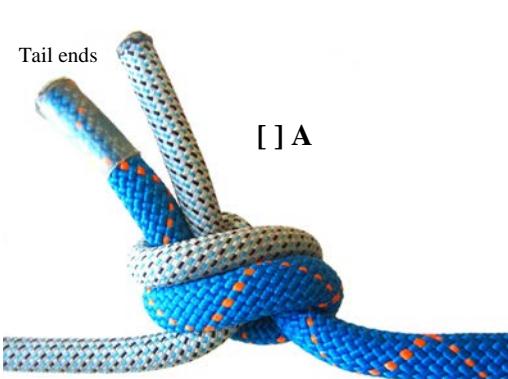
- Q37. Why is it important to ensure that the tails in all *end-to-end rope joining knots* are set to identical lengths?

Explain your answer: \_\_\_\_\_  
\_\_\_\_\_

- Q38. Study the photos carefully. Each parent knot (A and B) has been transformed into a particular geometry (at right). Indicate in each box the term which properly describes the knot geometry. You will be required to explain your answer...



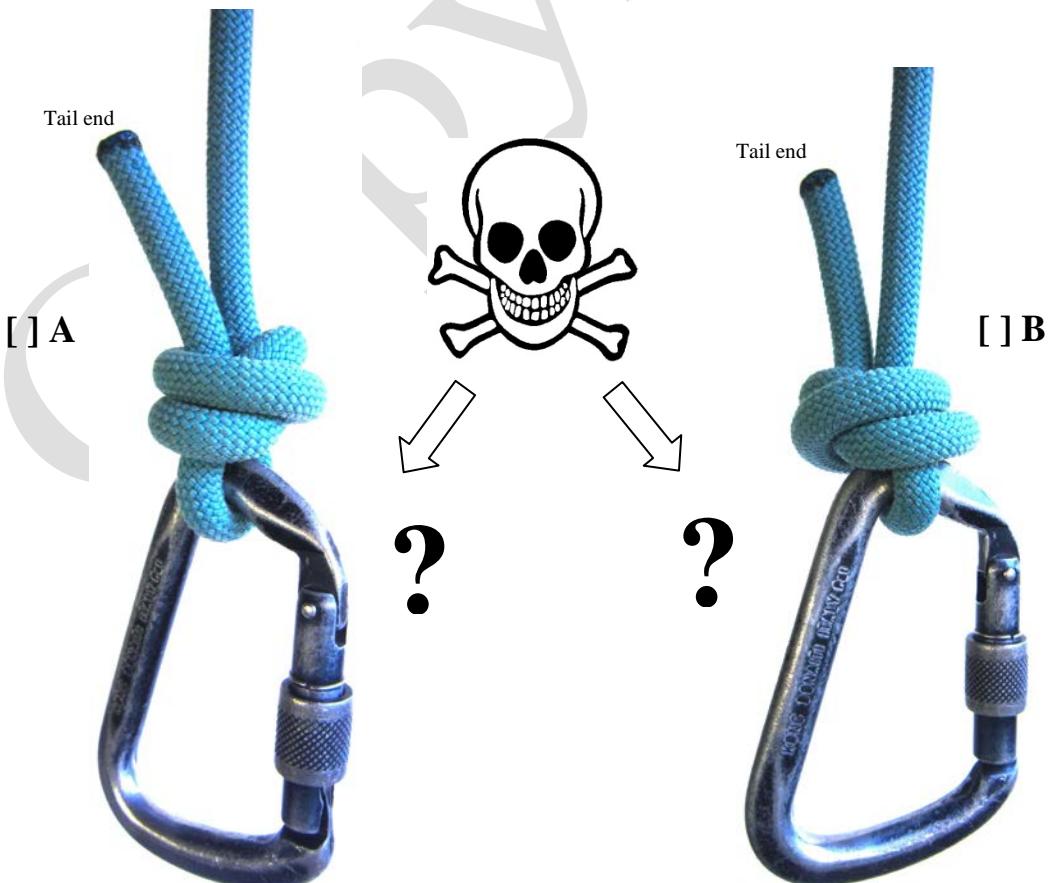
- Q39. Study the photos carefully. The knot has been tied using different rope diameters. Indicate the photo which shows the correct position/orientation of the ropes.  
You will be required to explain your answer...



Explain your answer: \_\_\_\_\_  
\_\_\_\_\_

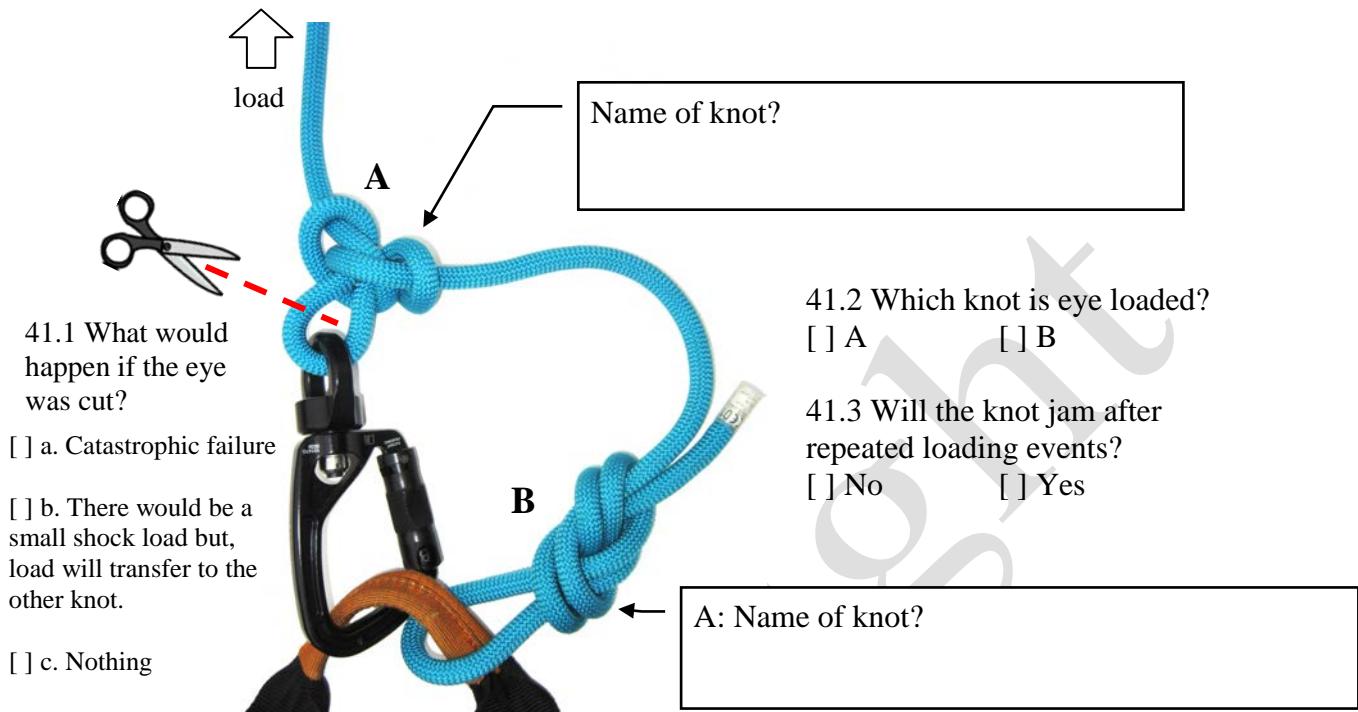
- Q40. Study the photos carefully. One of the photos indicates a correctly tied double overhand noose (ABoK #409) – the other is incorrectly tied and is **dangerous**. Indicate the photo which shows the **correct** form.

You will be required to explain *and* demonstrate your answer to your instructor. **Show your instructor how someone could accidentally tie the dangerous form.**



Q41. Study the photos carefully. This is a composite knot tie-in system that is typically used in indoor climbing gyms. One of the knots is always subjected to 'eye loading'. Does the *eye loaded knot jam* after repeated loading events?

Indicate which of the knots will be subjected to *eye loading* (A or B).



Q42. Study the photos carefully. When trusting your life to a Figure 8 eye knot, is it necessary to always tie a backup stopper knot?

[ ] YES – because the knot might slip apart

[ ] NO – it is an *inherently secure* knot  
(with appropriate minimum tail length)



Q43. All end-to-end joining knots (ie bends) have 4 corresponding fixed eye knots. Only 1 of the 4 possible corresponding eye knots for each ‘bend’ is shown in this question.  
Draw a line to link each of the end-to-end joining knots with its *corresponding* fixed eye knot.



A



1



B



2



C



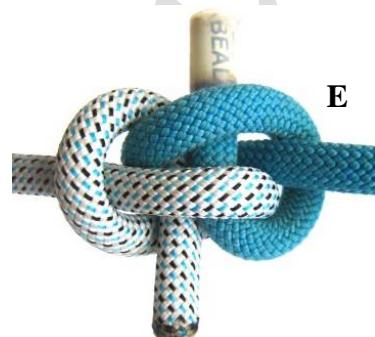
3



D



4



E



5

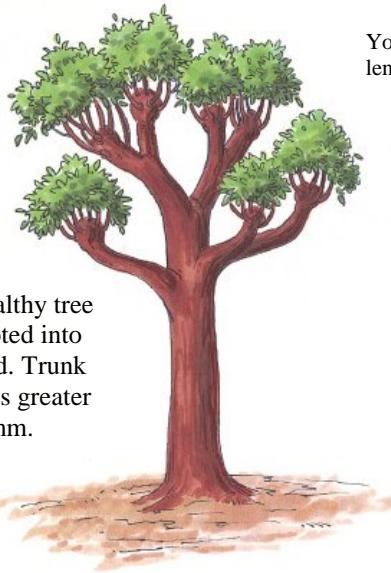


F



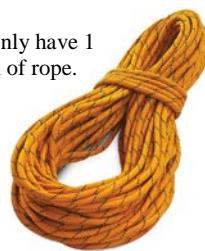
6

- Q44. You need to perform an abseil descent and the only available anchor point is a large, sturdy tree. **What type of knot would you use to secure the rope to the tree?** Sketch a diagram that shows how you would attach to the tree. Identify your chosen knot with a name. Assume that the tree can sustain in excess of 15kN force in the direction indicated.



Large, healthy tree – well rooted into the ground. Trunk diameter is greater than 600mm.

You only have 1 length of rope.



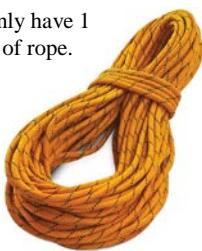
If you have difficulty sketching a diagram, you can describe your knot by name here:

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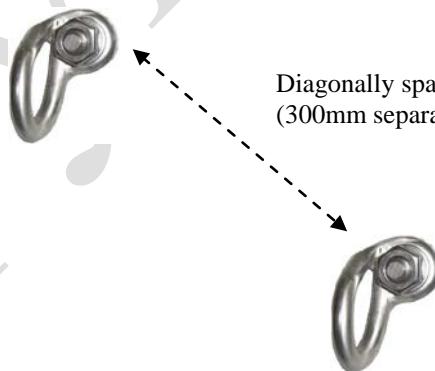


- Q45. You need to perform an abseil descent and the only available anchors are 2 existing permanently installed bolts. You must not use one (1) bolt on its own – they must be used as a pair so that load is *shared* across both bolts. Sketch a diagram to show how you would attach to the bolts. Assume that you have spare locking carabiners to clip to the bolts...

You only have 1 length of rope.

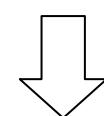


Diagonally spaced bolts (300mm separation)



What is the name of the knot(s) you chose?

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Direction of load

- Q46. Study the knots carefully. Some knots are both *Tiable In the Bight* (TIB) and able to be loaded *bi-axially* (through loading from SPart to SPart). Indicate which of the following TIB knots **cannot** be loaded bi-axially (it becomes unstable)?

Explain your answer: \_\_\_\_\_



- Q47. Study the knots carefully. Indicate which of the following knot structures is totally resistant to jamming? Identify the knot by name. There is only one correct answer...
- NOTE: All knots are shown loosely tied with short tails.

Name of knot you selected: \_\_\_\_\_

[ ] A



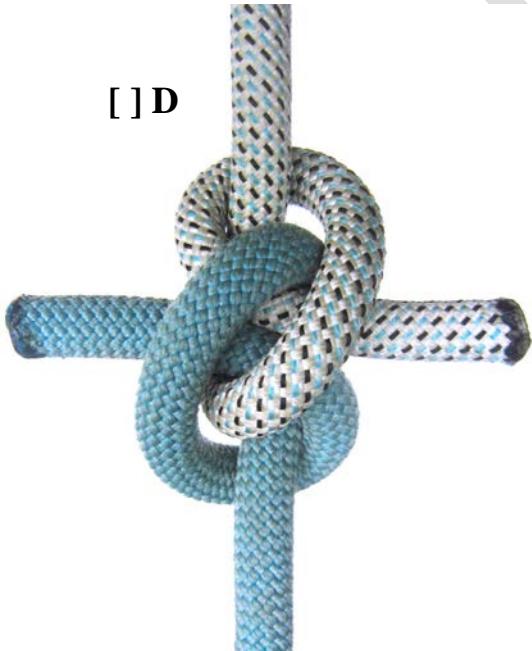
[ ] B



[ ] C



[ ] D



[ ] E



[ ] F



Q48. Study the knots carefully. It is often claimed that the Figure 9 (F9) eye knot is both ‘stronger’ and more resistant to ‘jamming’ than the #1047 Figure 8 (F8) eye knot.  
Are **both** of these assertions actually true? (you will be required to explain your answer)

48.1 [ ] Yes – the F9 has a higher MBS yield (ie strength) compared to the F8 and it is also more resistant to jamming.

[ ] No – it is an urban legend. Testing has demonstrated that the F9 in fact is more vulnerable to jamming (compared to F8). However MBS yield testing has shown that the F9 is only *marginally* higher compared to the F8.

48.2 Indicate the knot structure you believe is more resistant to jamming.



Explain your answer: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Final score \_\_\_\_\_

**Trainee statement:**

*I declare that I completed this exam paper without the assistance of others. My answers represent my own work and not the work of someone else. I realise that my exam score is an indication of my current knowledge in the area of knots used in life support applications. I acknowledge that my health and safety, and the safety of others may depend on my ability to consistently tie accurate knots.*

Trainee signature: \_\_\_\_\_ Date: \_\_\_\_\_