

NATIONAL EXAMINATIONS

December 2019

11-CS-2 ENGINEERING IN SOCIETY

HEALTH AND SAFETY

Three (3) hours duration

Notes to Candidates

1. This is a **Closed Book** examination.
2. **Do any five (5) questions.**
3. **All questions are of equal value.** (Each 10 marks).
4. **Five (5) questions constitute a complete paper.** (Total 50 marks).
5. Not all parts of any question are of equal value as some require more detailed answers than others.
6. **Read the entire question before commencing.**
7. Full explanations or descriptions must be given in essay type answers. Point form answers should not be given unless the question requires a list or has several distinct items. Sketches may be used to support explanations and descriptions.
8. If doubt exists as to the interpretation of any question, the candidate is urged to submit, with the answer paper, a clear statement of any assumptions made.
9. No calculators are required for this examination but either one of the approved **Casio** or **Sharp** calculators is allowed.
10. **Reference information for Question 7 is given on page 7. This page is to be returned with the Answer Booklet, showing lines generated or where readings were taken and which data was used. Candidates must write their names on this page.**

QUESTION 1 PERSONAL PROTECTIVE EQUIPMENT

Describe equipment for various operations or activities for protection of the following parts of the body:

- (a) Eyes and face.
- (b) Respiratory system (lungs including nose and mouth).

Clarify, in your answer, what activities or hazards require the protection described.

[10 marks]

QUESTION 2 ELECTRICAL SAFETY

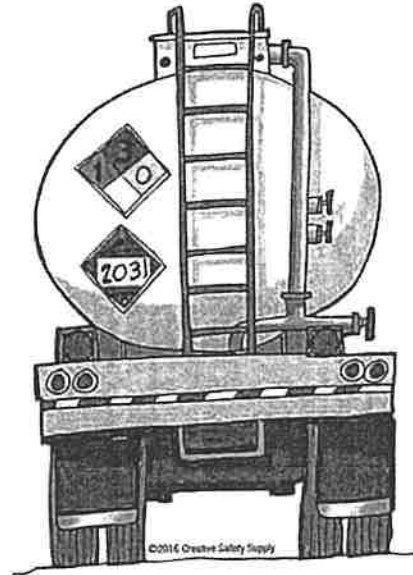
- (a) State what current levels have the following effects on the body:
Reference may be made to the chart on Page 6.
 - (i) Slight sensation.
 - (ii) Painful shock.
 - (iii) Severe shock with muscle contraction.
 - (iv) Death.
- (b) State whether women suffer the effects in (a) above at a higher or lower current level than men. Explain the reason why this is the case.
- (c) Explain the concept of double insulation in power tools and what determines this characteristic. State what type of plug (two pin or three pin) is usually found on such power tools. Give the reason for this choice.
- (d) Explain the difference between a fuse and a circuit breaker. State any advantages or disadvantages of their selection for an application. Explain how each works and what physical process initiates their operation.

[10 marks]

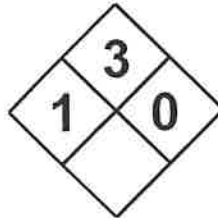
QUESTION 3 FIRE SUPPRESSION

(a) A truck bearing an NFPA symbol as shown in the adjoining sketch is involved in an accident. Some content has been spilt and a fire started. Determine the following and give reasons for your answers:

- (i) The likely contents of the truck.
- (ii) What action would be required by the fire fighters on the scene.
- (iii) What type of protective clothing should be worn by the fire fighters.
- (iv) What extinguishing agent should be used.



In case the black and white reproduction is not clear the numbers in the hazard diamond are repeated here.



(b) Sprinkler systems in industrial plants and commercial buildings may be either a "wet" system or a "dry" system.

- (i) Explain the difference between and mode of operation of a wet sprinkler system and a dry sprinkler system.
- (ii) Explain why a wet or dry sprinkler system would be specified for a particular application and what might be such applications.

[10 marks]

QUESTION 4 HEAT AND COLD

The normal body temperature is 37.5°C which is somewhat above comfortable environmental temperatures which allows for dissipation of heat generated by the body. Working conditions however may require work under excessively high or very low temperatures.

- (a) Consider exposure to excessively high temperatures while working.
 - (i) Describe the effects of excessively high temperatures on the human body.
 - (ii) Describe the symptoms of heat exposure and remedial action that would be required. Consider indices of stress.
 - (iii) Explain what environmental monitoring should be in place when workers are going to be exposed to excessively high temperatures.

- (b) Consider exposure to very low temperatures while working.
 - (i) Describe the effects of very low temperatures on the human body.
 - (ii) Describe the symptoms of exposure to cold and remedial action that would be required. Consider indices of stress.
 - (iii) Explain what environmental monitoring should be in place when workers are going to be exposed to very low temperatures.

[10 marks]

QUESTION 5 ERGONOMICS

Control panel instruments may be analog or digital.

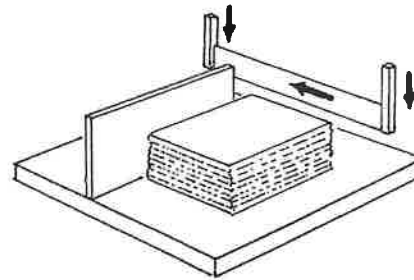
- (a) Give an example of the typical use of each type (analog and digital) and why this type would be chosen for the application. Give advantages and disadvantages of each type.

- (b) In an emergency situation a plant operator has to act quickly and correctly. Give examples of how each type (analog or digital) could be read incorrectly leading to an incorrect response and possible accident.

[10 marks]

QUESTION 6 MACHINE PROTECTION

A large electrically operated paper cutting guillotine has a long sharp blade which descends onto the cutting table in a slicing motion (simultaneous vertical and longitudinal motion). It is used for trimming books in a printing and binding establishment. The operator stacks the uncut pages of the book on a table as shown in the adjoining sketch and then operates the machine to trim the pages on one side to give a smooth finish to that side. After each cut the operator manually turns and re-aligns the stack against the stop for the next cut on another side.



Propose at least two different methods of ensuring that the operator's hands are not near the cutting blade during operation. Provide sufficient information for a technician to understand the proposed design and its philosophy and to implement the necessary protection. Support your proposals with appropriate sketches.

[10 marks]

QUESTION 7 RISK ASSESSMENT

Consider the following two occupations:

- (i) Drilling machine operator in an underground coal mine. (The operator has to ensure that holes are drilled in the coal face in the proper locations for explosive charges to be placed prior to blasting the next section of tunnel).
- (ii) Shift supervisor in a petro-chemical plant. (The shift supervisor has to do a walk around the plant every shift to check on the plant operators and maintenance crew and to verify that all processes are operating as required).

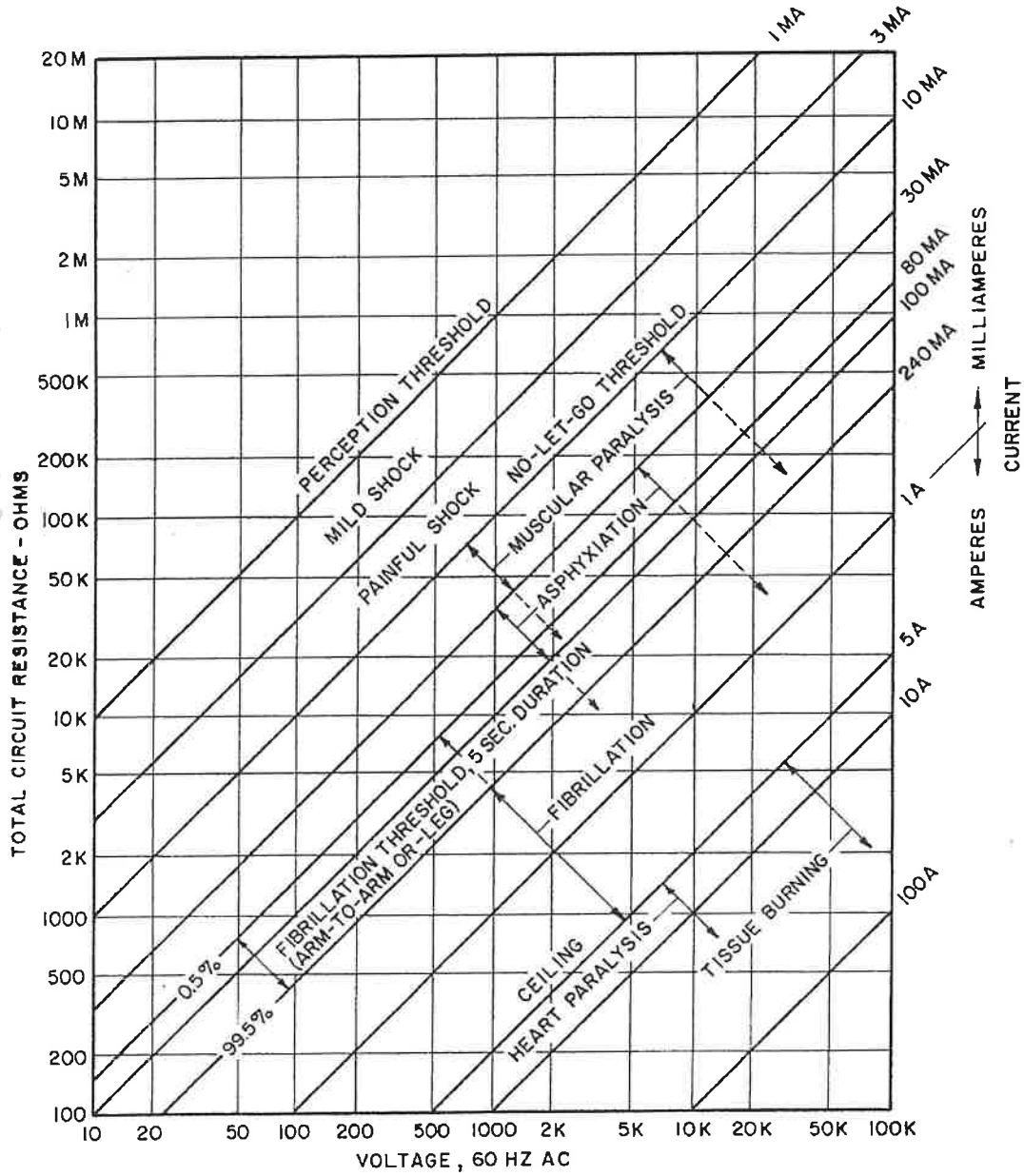
- (a) Using the chart on Page 7 evaluate the risk (risk score) of these two activities. Show by drawing lines on the chart how you obtained the answer. *The existing lines show the method to be used.*
- (b) Identify the hazards associated with each of these activities
- (c) Explain how the hazards identified in (b) above can be minimised and hence reduce the risk.

[10 marks]

EXAMINATION PAPER ATTACHMENTS

QUESTION 2 ELECTRICAL SAFETY

Effects of 60 Hz AC electric current on a 150 lb (68 kg) man
 ("Safety and Health for Engineers", Roger Brauer, 3rd Edition, Page 143).



EXAMINATION PAPER ATTACHMENTS

Name

QUESTION 7 RISK ASSESSMENT

Use the diagram below to assess the risk of the two occupations defined in Question 7.

Return this page with the answer booklet

