

Student name:
Number:
Section no:

7. 140 beats per minutes is defined as.
- Medium work
 - Medium to heavy work
 - Heavy work
 - extremely heavy work
8. One of the following statements is correct.
- The relationship between the heart rate and the oxygen consumption is linearly and reliable only in the range between light and heavy work.
 - The heart-rate has a high interaction with the metabolic system.
 - The breathing rate might increase up to 45 times in a minute during heavy exercising.
 - Bothe A and B are correct.
 - All the statements are correct.

Question2 (10 marks):

Fill in the blank space with the best answer:

- Lifting Index a term that provides a relative estimate of the level of physical stress associated with a particular manual lifting task.
- Static muscle work requires more than 12 times longer than the original contraction-duration for complete recovery from fatigue.
- Asymmetry Line Connecting mid-point between ankles and midpoint between hand grasps at origin or destination of lift.
- Moderate duration or 2 hours work pattern is categorized if the ratio of work-time (WT) to recovery-time (RT) is 0.3.
- The coefficient of variance (CV) for the body dimensions data is 3-10%.
- Design for the shortest person considered as design for extreme.
- For longer contraction duration one should apply 15% of muscle strength.
- Smooth Lift on PTC is a technical requirement for using NIOSH revised lifting equation.
- Sagittal Line is a line perpendicular to the hips and intersecting mid-point between ankles in neutral body posture.
- The learning curve phenomenon is refer to the reduction in cycle time that occurs in repetitive work activity as the number of cycle's increases.

Student name:
Number:
Section no:

Question 1 (8marks):

Choose the best answer for each of the following:

1. One of the following statements is true about muscle activity:
 - a. The tension produced by the muscle and transmitted through tendons is the muscle exertion.
 - b. The force is the observable result of a muscle movement or exertion.
 - c. Muscle activity is described based on their exertion and length.
 - d. All the above are true statements.
 - e. None of the above is true.
2. A cardboard box has two cut outs as carry handles, but the cardboard is thin and creates pressure concentration on the hands; according to the NIOSH lifting equation application guidelines this case is judged as having:
 - a. poor coupling
 - b. fair coupling
 - c. excellent coupling
 - d. good coupling
3. The following is a true fact about grip strength except:
 - a. Bending your wrist will result in reducing the potential grip strength
 - b. The muscles controlling the grip strength is located in the arm.
 - c. It can be measured using a hand dynamometer
 - d. It is used for estimating whole body strength
4. Dynamic (functional) anthropometric measurements:
 - a. Must be taken from a seated individual
 - b. Must be collected on a moving individual
 - c. Are only defined for 5th and 95th percentile individuals
 - d. Allow the sizes of several body dimensions to be simultaneously considered.
5. When designing for strength, one should consider the strength of :
 - a. 5th percentile
 - b. 50th percentile
 - c. 95th percentile & 5th percentile
 - d. 95th percentile

fit weaker 5th
6. The revised (1991) National Institute for Occupational Safety and Health (NIOSH) Lifting Equation does not apply if the following occurs:
 - a. lifting/lowering flexible objects
 - b. lifting/lowering in an restricted workplace
 - c. lifting/lowering while carrying, pushing, or pulling
 - d. lifting/lowering in an environment where the temperature is 79° F (26° C) and the relative humidity is 50%(optimal environment)

Student name:

Number:

Question 2 (6 marks):

Discuss the following:

1. "More Muscle work is required to grip an object when the wrist is bent"

Bending the wrist creates friction when these tendons move, therefore more muscle work is required to grip an object when the wrist is bent.

2. Changing the grip size, results in different grip strength for the same subject (person).

Optimal Grip Size: Each person has an ideal grip size where they can exert maximum strength, engaging hand and forearm muscles fully.

Small Grips: Grips that are too small reduce grip strength, as fingers and tendons must contract more, causing strain.

Large Grips: Overly large grips make it difficult to wrap the hand fully, leading to decreased grip strength and quicker fatigue..

3. 15% of MVC result in discomfort and pain on the muscles.

Nerve Compression and Stress: Low but prolonged force application can compress nerves and tendons, especially in small muscles used in fine motor tasks. This can result in pain or numbness, as the nerves and surrounding tissue become irritated from the constant pressure.

Question 3 (6 marks):

Based on the anthropometric data in the tables provided with the exam paper, determine each of the following:

- a- The coefficients of variance for females elbow height standing.

$$\frac{6}{5} \times 100\%$$

- b- The 20th percentile for male's stature height.

$$\frac{20}{100} \times (1+N) = P$$

- c- A female eye height sitting of 75cm correspond to a percentile of:

Student name:
Number:
Section no:

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 - extremely heavy work

8. One of the following statements is correct.
- The relationship between the heart rate and the oxygen consumption is linearly and reliable only in the range between light and heavy work.
 - The heart-rate has a high interaction with the metabolic system.
 - The breathing rate might increase up to 45 times in a minute during heavy exercising.
 - Bothe A and B are correct.
 - All the statements are correct.

Question2 (10 marks):

Fill in the blank space with the best answer:

- _____ a term that provides a relative estimate of the level of physical stress associated with a particular manual lifting task.
- Static muscle work requires more than 12 times longer than the original contraction-duration for complete recovery from fatigue.
- _____ Connecting mid-point between ankles and midpoint between hand grasps at origin or destination of lift.
- Moderate duration or 2 hours work pattern is categorized if the ratio of work-time (WT) to recovery-time (RT) is _____.
- The coefficient of variance (CV) for the body dimensions data is $= SD/mean * 100\%$
- Design for the shortest person considered as design for Design for extreme individual
- For longer contraction duration one should apply 15% of muscle strength.
- _____ is a technical requirement for using NIOSH revised lifting equation.
- _____ is a line perpendicular to the hips and intersecting mid-point between ankles in neutral body posture.
- The learning curve phenomenon is _____

Question 3 (12 marks)

Fill in the blank space with the best answer:

1. X

The main objective of measuring physical workload experiment is

measure strength evaluation system (not sure)

2. flexibility

3. anthropometry

4. body

5. exertion

6. produce force.

7. The heart and oxygen consumption have a linear and reliable relationship in the range between

8. Static strength is stressful in the conditions including:

9. The heart rate and oxygen consumption have a linear and reliable relationship in the range between

10. MVC is an indication of the muscles:

11. muscle endurance The ability of a muscle to sustain repeated contractions over a period of time without becoming exhausted.

12. The oxygen needed to release energy in the nutrient metabolism is in the ration of

13. isotonic muscle is the Dynamic muscle activity where muscle either contracts or elongates

14. The FITTING DESIGN is a design principle that lay on the

15. A heavy work is correspond to heart rate of

high force/ awkward posture/ Duration of time that the muscles are contracted

maximum voluntary muscular exertion (contraction) which is the Dynamic Strength of a muscle while in motion.

Designing for adjustable range

Question 1 (8marks):

Student name:
Number:
Section no:

Chose the best answer for each of the following:

1. One of the following statements is true about muscle activity:
 - a. The tension produced by the muscle and transmitted through tendons is the muscle exertion.
 - b. The force is the observable result of a muscle movement or exertion.
 - c. Muscle activity is described based on their exertion and length.
 - ☒ d. All the above are true statements.
 - e. None of the above is true.
2. A cardboard box has two cut outs as carry handles, but the cardboard is thin and creates pressure concentration on the hands; according to the NIOSH lifting equation application guidelines this case is judged as having:
 - a. poor coupling
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4. Dynamic (functional) anthropometric measurements:
 - a. Must be taken from a seated individual
 - ☒ b. Must be collected on a moving individual
 - c. Are only defined for 5th and 95th percentile individuals
 - d. Allow the sizes of several body dimensions to be simultaneously considered.
5. When designing for strength, one should consider the strength of :
 - ☒ a. 5th percentile
 - b. 50th percentile
 - c. 95th percentile & 5th percentile
 - d. 95th percentile
6. The revised (1991) National Institute for Occupational Safety and Health (NIOSH) Lifting Equation does not apply if the following occurs
 - a. lifting/lowering stable objects
 - b. lifting/lowering in an unrestricted workplace
 - c. lifting/lowering while carrying, pushing, or pulling
 - d. lifting/lowering in an environment where the temperature is 79° F (26° C) and the relative humidity is 50%(optimal environment)

Student name:
Student Number:

Question 1(10 points):

The following table present the recorded data of a student assigned to a strength evaluation experiment using the Jackson platform (load and the time spent in lifting each loads).

Analyze and answer each of the following requirements:

1. define the endurance limit:
2. If the maximum lifting capacity for the student was 350, plot the percentage of the maximum muscle exertion and discuss the endurance limit.
3. Find the muscle strength that the student can preserve for 8 hour industrial shift duration.
4. Discuss the following: Is the static muscle strength measured in this experiment more stressful compared to the dynamic muscle strength.

Experiment NO	Load in KG	Time	
1	31	45 sec	
2	24.5	1.20 min	
3	17	2min	
4	12.5	2. 30min	
5	11	3.50min	
6	7	8min	

Question 1

Not yet
answered

Marked out of
2.0

Flag question

Which of the following statement is not true about the muscle strength and the muscle endurance limit

Select one:

- ☐ The more strength exertion required of a given muscle, the shorter the period is through which the strength can be maintained.
- ☒ The relationship between the strength exertion and the period time applies strictly to static, or isometric, efforts only.
- ☐ Fatigue of the muscle depends on the frequency and intensity of muscular contraction and the period of time over which it is maintained.
- ☐ the endurance curve demonstrate the relationship between the load lifted and the period of time over which it is maintained.

Quiz navigation

1	2	3	4
10	11	12	13
19	20	21	22

Finish attempt ...

Time left 0:59:18

Question 2

Not yet
answered

Marked out of
10.0

match between each of the following terminology and its definition

The tension produced by muscles and transmitted through tendons to produce force.

Choose...

Question 4

Not yet answered

Marked out of 2.0

🚩 Flag question

the designing principle used when designing clothes is:

Select one:

- ☐ designing for adjustable range
- ☐ Design for extreme individual.
- ☐ Fitting design
- ☒ 1+3
- ☐ Designing for the average.

Quiz navigation

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24			

Finish attempt...

Time left 0:58:51

Question 5

Not yet answered

Marked out of 2.0

🚩 Flag question

When measuring the body strength using the hand dynamometr the lowest recorded values were for the...

Select one:

- ☐ None dominant hand 5 cm griping size with full griping
- ☐ Dominant hand 6 cm griping size with full griping .
- ☐ Dominant hand 3.5 cm griping size with full griping
- ☐ Dominant hand 5cmgriping size with full griping.
- ☒ Dominant hand 5cm griping size with half griping.

Question 6

Not yet
answeredMarked out of
2.0

🚩 Flag question

When designing for strength, one should consider the strength of :

Select one:

- ☐ 95th percentile & 5th percentile
- ☒ 5th percentile
- ☐ 50th percentile
- ☐ 95th percentile

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● Fill in the blank space with the correct answer:

----- is the study of the physical dimensions, proportions and composition of the human body.

Answer: Anthropometry

When designing for strength, one should consider the strength of :

Answer: arm-hand steadiness

Static muscle work requires more than 12 times longer than the original contraction-duration for complete recovery from fatigue.

Select one:

☒ True

☐ False

Muscles are strongest nearest at the beginning of contraction

Select one:

☒ True

☐ False

N FACTOR & WORK MEASUREMENT LAB

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Build up of waste products (lactic acid) in muscle tissue creates discomfort/pain.

Select one:

☒ True

☐ False

☐ Slightly lower than the keyboard for ease of movement.

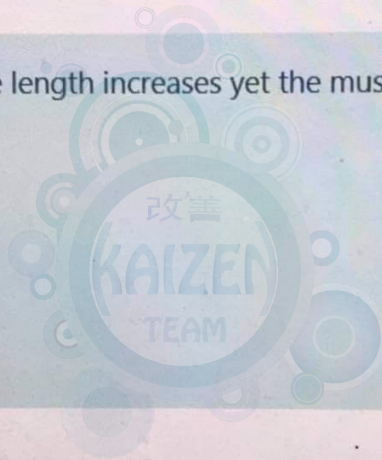
[Clear my choice](#)

☒ Isometric muscle activity is when muscle length increases yet the muscle tension does not change.

Select one:

☐ True

☒ False



● The height of the computer mouse should be at:

Select one:



Slightly lower than the keyboard for ease of movement.



Slightly higher than the keyboard to relief shoulder tension.



Elbow height



Same height as the keyboard

[Clear my choice](#)

● Static muscle work requires more than 12 times longer than the original contraction-duration for complete recovery from fatigue.

Select one:



True



False

Quiz navigation

1	2	3
10	11	12
19	20	21

Finish attempt

Time left 0:19:38

- ☐ 95th percentile
- ☐ 95th percentile & 5th percentile
- ☒ 5th percentile
- ☐ 50th percentile

[Clear my choice](#)

17

All of the following are true about fatigue, Except:

Select one:

- ☐ Caused by accumulation of waste from anaerobic metabolism
- ☐ Reduces human capacity to work
- ☐ May lead to injury
- ☒ Will not happen with aerobic work

18

Steadiness requires a higher visual acuity in its applications more than Aiming.

- Steadiness requires a higher visual acuity in its applications more than Aiming.

Select one:

☐ True

☒ False

Fill in the blank space with the correct answer:

according to the strength evaluation system experiment
the isometric strength of the body muscles in a standing position is

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Question 17

Answer saved

Marked out of 2.0

Flag question

Fill in the blank space with the correct answer:

_____ is the ability to hold one's hand and arm in a specific position for a relatively short period of time.

Answer: Arm- Hand Steadiness

Question 18

Answer saved

Marked out of 2.0

Flag question

Ergonomics is a branch of knowledge concerned with:

Select one:

- ☒ All of the above
- ☐ Design of tools, machines, systems, tasks, jobs, and environments
- ☐ Human abilities
- ☐ Fitting the job or task to the person

[Clear my choice](#)

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HUMAN FACTOR & WORK MEASUREMENT LAB

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Question 22

Never saved

100% out of

1 question

The following is a true fact about grip strength except:

Select one:

- ☐ It can be measured using a hand dynamometer
- ☐ It is used for estimating whole body strength
- ☒ The muscles controlling the grip strength is located in the arm.
- ☐ Bending your wrist will result in reducing the potential grip strength

[Clear my choice](#)

Question 23

Never saved

100% out of

1 question

Build up of waste products (lactic acid) in muscle tissue creates discomfort/pain.

Select one:

- ☒ True
- ☐ False

Type here to search



Student name:
Number:
Section no:

The University Of Jordan
School of Engineering
Department of Industrial Engineering

Lab. of Human Factor and work measurements.
2nd semester 2021/2022

Course instructor: Eng. Rawan AL-Tarawneh

Midterm Exam (30%)

Date: 13-4-2022

Time: 45 Minutes

Question 1 (12 marks):

A-Fill in the blank space with the best answer:

1. Muscles providing grip strength are located in Forearm.
2. For longer contraction duration one should apply 15% of muscle strength.

Gender/ Conditioning/ Size/ Predisposing conditions

3. flexibility is one of the factors that affects body strength.

4. flexibility is the ability to bend without sustaining any injury.

5. The grip strength can be measured by using Hand Dynamometer.

5. The coefficient of variance (CV) for the body dimensions' data is $\frac{SD}{mean} * 100\%$.

6. Human capacity to exert force is highest at nearest at the beginning of contraction.

7. Design for the heaviest person considered as design for Design for extreme individual.

Isometric Muscle

8. Isometric is a muscular process where muscle tension increases while it's approximately remains at the same length.

B- Discusses the following:

Static muscle work requires longer recovery times than dynamic work.

static muscles need 12 times the time to recover from fatigue.

→ fatigue increase the muscles have the same length.

when muscle contraction there is no or little blood flow. Lactic acid accumulated in the tissue in the muscles.

Changing the grip size, results in different grip strength for the same subject (person).

grip strength is proportional with the grip and finger size (thumb size).

which is different from person to another.

Student name:

Number:

Section no:

Question 2 (12 marks):

- a. Define the Anthropometry: *the study of physical dimensions and proportions and comparison in the human body.* ✓

The measurements shown in the figure below were used as a reference to design a chair for a sitting workstation.

- b. Name each of the measurements shown in the figure (from 1-4).
 c. What is the feature of the chair each dimension in the figure was used for?
 d. Indicating the critical determinant (the designing principles) that is used when designing each of this dimension.
 e. What is the percentile that represents a measure of 40 cm for a female of dimension number 1 (use the anthropometric data in the tables provided with the exam paper)

$$SD = 2.37$$

$$\bar{X} = 38.94$$

$$X = 40 \text{ cm}$$

$$X > \bar{X}$$

$$X = \bar{X} + K \cdot SD$$

$$40 = 38.94 + K(2.37)$$

$$1.06 = K(2.37)$$

$$K = 0.447$$

$$0.67 \leq K \leq 0$$

$$75 < < 50$$

$$\frac{75+50}{2}$$

$$\text{percentile} = 62.5\%$$

$$[62]$$

Interpolation

(Use the following table to complete your answers)



Measurement name	feature of the chair	designing principles
1. popliteal height (sitting)	height of the chair	adjustment (range)
2. patellar-popliteal depth	depth of the chair	design for average
3. elbow height (sitting)	forearm 90° with arm (elbow)	design range
4. hip breadth (sitting)	width of the chair for sitting one	extreme (max)

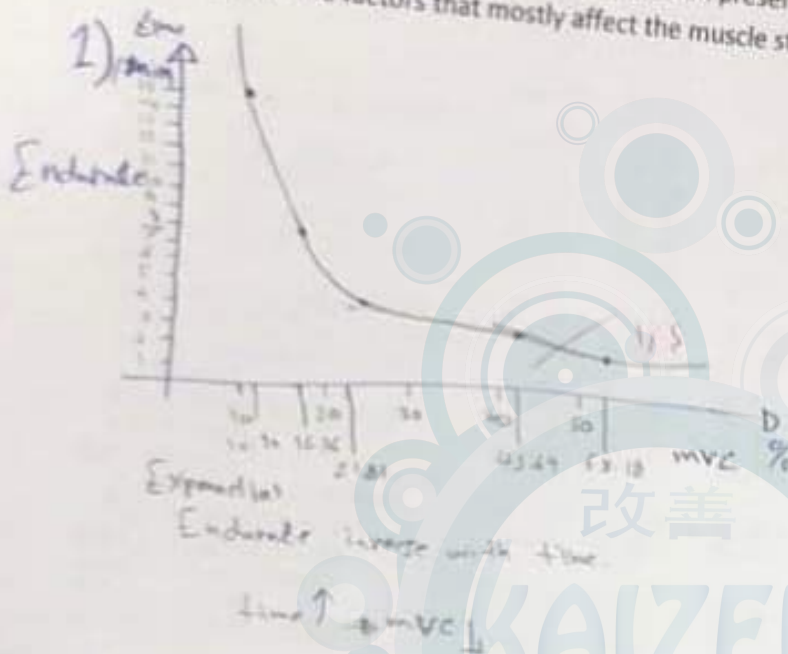
Question 3 (6 marks)

Student name:

Number:

Section no:

- The following table present the recorded data of a subject assigned to a strength evaluation experiment using the Jackson platform; using the data below Draw the endurance time against the percentage of the maximum muscle strength if the maximum lifting capacity for the subject was 55 KG. (comment on you drawing)
- Find the muscle strength that the subject can preserve for 8 hours' industrial shift duration.
- What are the factors that mostly affect the muscle strength and muscle endurance?



Experiment NO	Load in KG	Time in MIN	?
1	32	2	58.12
2	24	3	43.64
3	12	4	21.81
4	9	8	16.36
5	6	15	10.90

- 2) $8 \times 60 = 480 \text{ min}$
 when we ↑ time ↓ then it approach to zero.
 time ↑ MVC ↓

- 3) ① Gender (women have 2/3 from strength the man)
 ② Condition (athletic condition (weightlifting vs marathon Runner))
 ③ Size, Location of the muscles
 ④ predisposing condition (such as, injury or previous injury)
 Genetic
 Genetic
- if muscles are used
 static load stressful
 - awkward posture
 - high force
 - period of time that muscles contraction.

Question 1(10 points):

The following table present the recorded data of a student assigned to a strength evaluation experiment using the Jackson platform (load and the time spent in lifting each loads).

Analyze and answer each of the following requirements:

1. define the endurance limit:
2. If the maximum lifting capacity for the student was 35KG, Plot the time Vs the percentage of the maximum muscle exertion and discuss the endurance limit.
3. Find the muscle strength that the student can preserve for 8 hours industrial shift duration.
4. Discuss the following: the static muscle strength measured in this experiment is more stressful compared to the dynamic muscle strength.

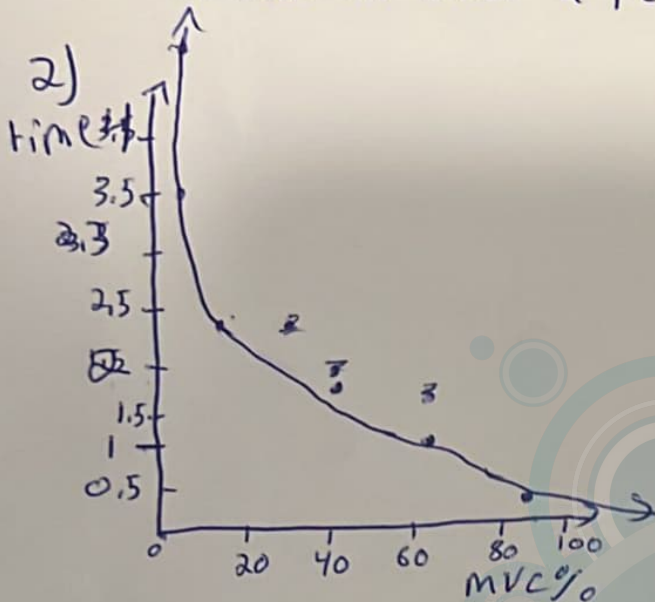
Experiment NO	Load in KG	Time
1	31	45 sec
2	24.5	1.20 min
3	17	2min
4	12.5	2. 30min
5	11	3.50min
6	7	8min

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1) Endurance: the ability of a muscle to sustain repeated contractions over a period of time without becoming exhausted



MVC = $\frac{31}{35} \times 100\%$

$\frac{24.5}{35} \times 100\%$

	kg	Time	MVC%
1	31	45 sec	88.6%
2	24.5	1.2 min	70%
3	17	2 min	48.6%
4	12.5	2.3 min	35.7%
5	11	3.5 min	31.4%
6	7	8 mins	20%

3) For long ^{8 hours} duration, muscle voluntary retraction (MVC) should be 15% of its max%

$35 \times 15\% = 5.25$

4) In static muscle strength, the tension increase, ^{length} ~~size~~ of muscle is the same; causing little to no blood flow which causes the build of lactic acid.

?

- if the MVC for a logistic worker found to be 35 KG, what is the maximum load this worker can lift during an 8 hours shift with

kg

$$35 \times 15\%$$

Human capacity to exert force is highest when in neutral posture

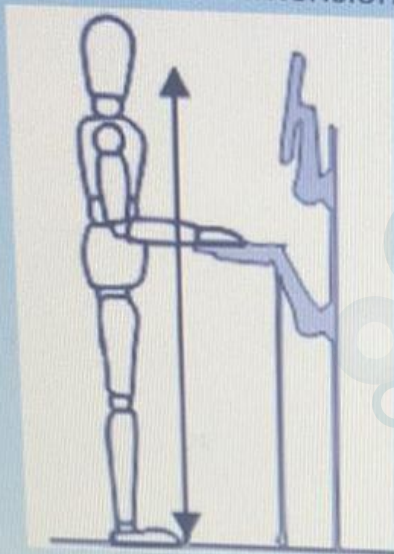
one of the following is not correct about the grip span when using the hand dynamometer

- ☒ a. changing the grip span result in different grip strength.
- ☐ b. power griping is used in measure the grip strength.
- ☒ c. the grip strength increases as the grip span increase
- ☐ d. None, all answers are correct about the grip span.
- ☐ e. the grip strength have a direct relationship with the palm and fingers dimensions.

Clear my choice

Fatigue is only explained by the decrease in Oxygen availability to the muscles.

the reference dimension used for the monitor height in this computer workstation is



- ☐ a. elbow height standing
- ☐ b. standing height
- ☐ c. eye height sitting
- ☐ d. None of the answers
- ☒ e. eye height standing

Which of the following tests must be done for a person who is applying for a job of lifting heavy cans from assembly line and putting them in large boxes

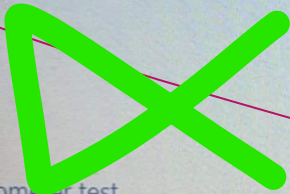
Select one:

☐ Mirror-tracer test

☐ Aiming test

☐ Hand-Dynamometer test

☐ None of the above



Question 19

Not yet
answeredMarked out of
2.0

Flag question

Fill in the blank space with the correct answer:

_____ is the ability to hold one's hand and arm in a specific position for a relative

Answer: Muscular Endurance

Question 20

Not yet
answeredMarked out of
1.0

Flag question

Muscles are strongest nearest at the beginning of contraction

Select one:

☒ True☐ False

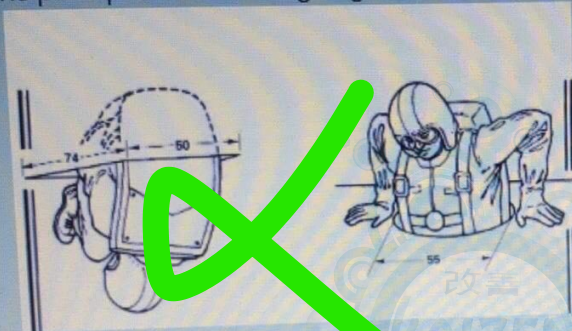
Question 16

Not yet
answered

Marked out of
1

Flag
question

the principle used in designing the following application shown in the figure is :



- ☒ a. specific design-design for the adjustable range
- ☐ b. Maximum to fit-Design for extreme individual
- ☐ c. Design for adjustable range
- ☐ d. Design for the average
- ☐ e. Fitting design -design for the adjustable a range

Quiz no

1	2
▲	
7	8
13	14
19	20

Finish atte

Time left 0

Actiya
Go to Se

Design is taken for the body in all of the following situations except:

choose the correct definition for each of the following

Muscle

Endurance

the ability of a muscle to sustain repeated contractions over a period of time with

Anthropometry

is the study of the physical dimensions, proportions and composition of the human

Exertion

defined as the tension produced by muscles and transmitted through tendons to

Flexibility

the ability to bend without sustaining any injury.

Isometric

Muscle Activity

is a Muscular process where muscle tension increases and the muscle are approx

Static Load

holding the same position for a period of time

MVC is an indication of the muscles strength

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Question 16

Answer saved

Marked out of 2.0

Flag question

one of the following statement is not true about the muscle strength and the muscle endurance limit

Select one:

- ☐ The more strength exertion required of a given muscle, the shorter the period is through which the strength can be maintained.
- ☒ The relationship between the strength exertion and the period time applies strictly to static, or isometric, efforts only.
- ☐ Fatigue of the muscle depends on the frequency and intensity of muscular contraction and the period of time over which it is maintained.
- ☐ the endurance curve demonstrate the relationship between the load lifted and the period of time over which it is maintained.

[Clear my choice](#)

Question 17

Answer saved

Marked out of 2.0

Flag question

Fill in the blank space with the correct answer:

----- is the ability to hold one's hand and arm in a specific position for a relatively short period of time.

Answer: Arm- Hand Steadiness

Question 18

Ergonomics is a body of knowledge concerned with:

☐ False

The coefficients of variance for female's Elbow-fingertip distance is

%

?

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Finish attempt

- ☐ 95th percentile
- ☐ 95th percentile & 5th percentile
- ☒ 5th percentile
- ☐ 50th percentile

Clear my choice

17

t

ed

g question

All of the following are true about fatigue, Except:

Select one:

- ☐ Caused by accumulation of waste from anaerobic metabolism
- ☐ Reduces human capacity to work
- ☐ May lead to injury
- ☒ Will not happen with aerobic work

18

er saved

Steadiness requires a higher visual acuity in its applications more than Aiming.



Question 17

Answer saved

Marked out of
2.0

Flag question

Fill in the blank space with the correct answer:

----- is the ability to hold one's hand and arm in a specific position for a relatively short period of time.

Answer: Arm- Hand Steadiness

Question 18

Answer saved

Marked out of
2.0

Flag question

Ergonomics is a body of knowledge concerned with

Select one:

- ☒ All of the above
- ☐ Design of tools, machines, systems, tasks, jobs, and environments
- ☐ Human abilities
- ☐ Fitting the job or task to the person

[Clear my choice](#)[Previous page](#)[Next page](#)