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Computing Infrastructures

Course 095897

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Student ID (codice persona):	Last Name / Cognome:
.....	.....
	First Name / Nome:
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Answers must be given exclusively on the answer sheet (last sheet): DO NOT FILL ANY BOX IN THIS SHEET

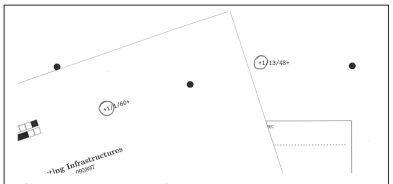
Students must use pen (black or blue) to mark answers (no pencil).
Students are permitted to use a non-programmable calculator.

Students are NOT permitted to copy anyone else's answers, pass notes amongst themselves, or engage in other forms of misconduct at any time during the exam.

Students are NOT permitted to use mobile phones and similar connected devices.

Scores: correct answers +1.5 point, unanswered questions 0 points, wrong answers -0.5 points.

Questions with multiple answers will be considered as not answered (0 points).



Check that the first number in the text and in the answer sheet is the same

A **Question 9:** ☐A ☐B ■C ☐D
Question 10: ☐A ☐B ■C ☐D
Question 11: ■A ☐B ☐C ☐D

If you make a mistake:

1. circle the word "Question"
2. write the correct answer to its side

Question 1: ■A ☐B ☐C ☐D
Question 2: ☐A ☐B ■C ☐D
Question 3: ☐A ■B ☐C ☐D
Question 4: ☐A ☐B ☐C ■D

Do not use crosses to mark the answers!
Completely fill the box!

Answer sheet: 104238 12

Student ID (codice persona):

☐0	■0	☐0	☐0	☐0	☐0	☐0	☐0
■1	☐1	☐1	☐1	☐1	☐1	■1	☐1
☐2	☐2	☐2	■2	☐2	☐2	☐2	☐2
☐3	☐3	☐3	☐3	■3	☐3	☐3	☐3
☐4	☐4	■4	☐4	☐4	☐4	☐4	☐4
☐5	☐5	☐5	☐5	☐5	☐5	☐5	☐5
☐6	☐6	☐6	☐6	☐6	☐6	☐6	☐6
☐7	☐7	☐7	☐7	☐7	☐7	☐7	■7
☐8	☐8	☐8	☐8	☐8	■8	☐8	☐8
☐9	☐9	☐9	☐9	☐9	☐9	☐9	☐9

Enter the numbers of your "Student ID" from left to right

Question 1 Which statement about Platform as a Service is not correct?

- [■] Gmail is an example of PaaS
- [B] PaaS accelerates the deployment
- [C] PaaS supports the scalability
- [D] PaaS provides developers with a programming-language-level environment and API

Explanation:

Question 2 Which statement about Paravirtualization is correct?

- [A] Occurs at Operating System-level by means of private Servers
- [■] Cannot be used with traditional Operating Systems
- [C] Is the same of Kernel-level Virtualization
- [D] Hooks are not required

Explanation:

In the following questions we will assume that both failure and repair events follow exponential distributions.

Question 3 Which definition is not encompassed by Dependability:

- [A] Availability: readiness for correct service
- [B] Maintainability: reparation to restore correct service
- [C] Reliability: continuity of correct service
- [■] Reversibility: ability to reverse a broken service

Explanation:
Reversibility is not part of Dependability.

Question 4
The analysis of the failure behavior of a two components system reveals that the system is down only when both its components are down. The two components A and B have the following characteristics: $\lambda_A = 0.005\ days^{-1}$, $MTTR_A = 6\ days$, $\lambda_B = 0.106\ days^{-1}$ and $MTTR_B = 2\ days$. The reliability of the system at $t = 9\ days$ is equal to:

- [A] 0.9560
- [■] 0.9729
- [C] 0.3852
- [D] 0.6721

Explanation:
$R_A(9) = e^{-0.005*9} = 0.9560$
$R_B(9) = e^{-0.106*9} = 0.3852$
$R_{sys} = 1 - (1 - 0.9560)(1 - 0.3852) = 0.9729$

Question 5 MTBF is calculated as:

- [A] MTBF does not exist
- [B] $\frac{1}{MTTF}$
- [C] $\frac{1}{MTTF+MTTR}$
- [■] $MTTF+MTTR$

Explanation:
Mean Time Between Failures is calculated as MTTF + MTTR.

Question 6 With Bridged Networking:

- [A] port-forwarding rules must be set to expose VM's ports on the network
- [B] requires the VMM to keep an internal table to map requests from and responses to each VM
- [C] the VMM provides an IP address to the VM
- [■] guests behave as physically connected to the network interface

Explanation:
Lesson_3_Virtualization_B.pdf, slide 56

Question 7 The Nested Pages mechanism:

- [■] is supported by the Translation Lookaside Buffer (TLB)
- [B] is completely managed by the VMM software
- [C] implies more software-level overhead than the Shadow Pages mechanism
- [D] does not require special hardware to support it

Explanation:
Lesson_3_Virtualization_B.pdf, slide 31

Question 8 A system is composed by 3 physical machines (Host1, Host2, Host3), with subnet addresses: 192.168.0.1, 192.168.0.2 and 192.168.0.3 (default subnet mask: 255.255.255.0). Two Virtual Machines, VM1 and VM2 run over Host1, connected in bridged mode. Other two Virtual Machines, VM3 and VM4 run over Host2, connected in NAT mode. Finally, the last Virtual Machine, VM5, run over Host3, with internal networking. Assuming that port-forwarding is configured to map port X of the guest on the same port X on the host and that IPs are provided incrementally by the DHCP server on the network:

■ a service running inside VM2 and listening on port 8080 can be reached at the address: 192.168.0.5:8080

B none of the other answers is valid

C VM5 can be reached only by Host3

D a service running inside VM3 and listening on port 22 can be reached at the address: 192.168.0.6:22

Explanation:
Even the host cannot reach a VM with internal networking; VM3 is NATted, so it can only be reached on IP: 192.168.0.2; assuming that IPs are provided incrementally by the DHCP server on the network, VM2 will then have IP: 192.168.0.5, exposing the service running on it.

Question 9
Consider a HDD with:

- data transfer rate: 240 MB/s
- rotation speed: 11000 RPM
- mean seek time: 19 ms
- overhead controller: 0.0 ms

The minimum locality required to achieve a mean I/O service time of 0.00 ms to transfer a sector of 4 KB will be:

A 0.78 ■ 1.00 C 0.34 D none of the others

Explanation:
Mean latency: (1/2 round) * (60s/min) * 1/(11000 round/min) = 2.7273 ms
Transfer time: (4 KB) / (240 * 1024 KB/s) = 0.0163 ms
Mean I/O service time (no locality) = 19 + 2.7273 + 0.0 + 0.0163 = 21.7436
Target mean I/O service time = 0.00 = (1 - locality) * (19 + 2.7273) + 0.0 + 0.0163
Locality (minimum) = 1 - (0.00 - 0.0 - 0.0163) / (19 + 2.7273) = 1.00

Question 10
Consider the following RAID 1 setup:

- n = 2 disks
- MTTR = 8 days
- MTTF(one disk) = 2400 day

The MTTDL will be:

A 1200 days	■ 360000 days	C 44999 days	D none of the others

Explanation:
$MTTDL = \frac{MTTF^2}{n*MTTR} = 360000$ days

Question 11
Consider the following RAID 5 setup:

- n = 4 disks
- MTTR = 2 days
- MTTF(one disk) = 1900 day

The MTTDL will be:

A none of the others	B 79 days	C 112812 days	■ 150417 days

Explanation:
$MTTDL = MTTF^2/(n*(n-1)*MTTR) = 150417 days$

Question 12
By monitoring a single class iteractive system, we are able to measure the following data:

- Monitoring period: 90 seconds
- CPU service time: 0.39 seconds/operation
- CPU utilization: 0.50
- Disk throughput: 10 operations/second
- Disk visits: 15 operations/transaction
- Response time: 1.8 seconds/transaction
- Number of users: 17

Which is the average think time of these users?

■ 23.70 sec B 88.20 sec C 0.00 sec D 25.50 sec

Explanation:
X = Xdisk / Vdisk = 0.666666666666666666
Z = N/X - R = 23.70

Question 13
Consider a closed system with the following data: average number of users: 21 ($N = 21$) average response time: 39 sec ($R = 39$), average throughput: 0.51 trans/sec ($X = 0.51$), average CPU service demand: 0.83 sec/trans ($D_{\mathrm{CPU}} = 0.83$). Which is the CPU utilization?

A 0.61 B 0.58 ■ 0.42 D 0.02

Explanation:
Ucpu = X*Dcpu

Question 14
Consider a single-class multi station system with two stations. We have the following information about the system:

- station 1 response time: 8 seconds
- station 2 response time: 3 seconds
- station 1 throughput: 4 transactions/second
- station 2 throughput: 5 transactions/second
- system throughput: 4 transactions/second

Which is the average response time of the system?

[A] 0.56 sec [B] 11.00 sec [■] 11.75 sec [D] 8.66 sec

Explanation:
V1 = X1 / X
V2 = X2 / X
R1 = r1 V1
R2 = r2 V2
R = R1 + R2

Question 15
Consider the following measurement data for an interactive system

- measurement interval: 5 minutes
- number of users: 47
- number of servers: 24
- average response time per transaction: 21 seconds
- Dmax 1.1 sec/transaction
- Dtot 2.6 sec/transaction
- number of completed transactions: 72

On average, how many users are thinking?

[A] 5.04 [■] 41.96 [C] 28.03 [D] 16.76

Explanation:
Nthink = N - Nnot-think
Nnot-think = X R
X = C / T

Question 16
Consider a closed system with the following data: average number of users: 21 ($N = 21$) average response time: 27 sec ($R = 27$), average throughput: 0.42 trans/sec ($X = 0.42$), average CPU service demand: 0.67 sec/trans ($D_{\text{CPU}} = 0.67$). Which is the average think time Z of a user?

■ 23.00 sec B 4.34 sec C 31.34 sec D 50.00 sec

Explanation:
Z = N/X - R

Question 17
Consider a closed queuing network with the following characteristics:

- service demand Dmax = 0.8 sec
- service demand Dtot = 2.0 sec
- think time Z = 1 sec
- number of users N = 3

Which is the asymptotic lower bound of response time?

■ 2.00 sec B 1.01 sec C 1.41 sec D 1.15 sec

Explanation:
$\max(D, ND_{max} - Z) = \max(2.0, 3 \times 0.8 - 1) = 2.00$

Question 18
Consider a closed queuing network with the following characteristics:

- service demand Dmax = 2.1 sec
- service demand Dtot = 2.2 sec
- think time Z = 2 sec
- number of users N = 3

Which is the asymptotic lower bound of throughput?

A 0.48 tran/sec B 0.45 tran/sec C 0.27 tran/sec ■ 0.35 tran/sec

Explanation:
$\frac{N}{ND+Z} = \frac{3}{3\times 2.2+2} = 0.35$

Question 19
Consider a closed queuing network with the following characteristics:

- service demand Dmax = 0.6 sec
- service demand Dtot = 1.6 sec
- think time Z = 0.8 sec
- number of users N = 3

Which is the asymptotic upper bound of response time?

■ 4.80 sec B 1.00 sec C 3.82 sec D 4.06 sec

Explanation:
$ND = 3 \times 1.6 = 4.80$

Question 20
Consider a closed queuing network with the following characteristics:

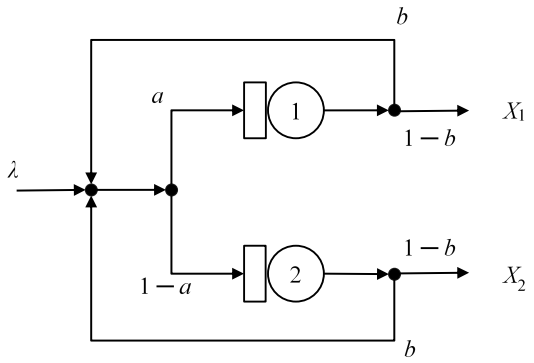
- number of stations K = 1
- service demand Dmax = 2.1 sec
- service demand Dtot = 3.5 sec
- think time Z = 0 sec
- number of users N = 4

Which is the **balanced** lower bound of response time?

A 8.40 sec B 17.50 sec C 29.75 sec ■ 14.00 sec

Explanation:
$\max(D_{tot} + (N-1) * D_{avg}, ND_{max} - Z) = \max(3.5 + (4-1) \times 3.50, 4 \times 2.1) = 14.00$

Question 21 Consider the following open network, where a and b are routing probabilities. Which is the number of visits at station 1?



A $a + b$ ■ $a/(1-b)$ C a D $a * b$

Explanation:
V1 = a*(1 + V1*b + V2*b) = a*[1 + b*(V1 + V2)]
V2 = (1-a)*(1 + V1*b + V2*b) = (1-a)*[1 + b*(V1 + V2)]
V2/V1 = (1 - a)/a = 1/a - 1
V2 = V1/a - V1
V1 = a*(1 + b*V1/a) = a + V1*b
V1*(1 - b) = a

Question 22
Consider a single-class open queuing network with the following characteristics:

- Visits station A (Va): 1.4
- Visits station B (Vb): 0.8
- Service time station A (Sa): 0.28 sec/tran
- Service time station B (Sb): 0.20 sec/tran
- Arrival rate (λ): 1.59 tran/sec

Which is the system response time?

A 1.011 sec/tran
■ 1.255 sec/tran
C 0.552 sec/tran
D 1.996 sec/tran