AceGAMSAT

GAMSAT Mock-Exam

Solutions

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AceGAMSAT Study Material

The following GAMSAT package covers all three sections of the GAMSAT.
The section 3 study guides are particularly useful for this mock-exam as they cover all science topics in the required depth for the GAMSAT.

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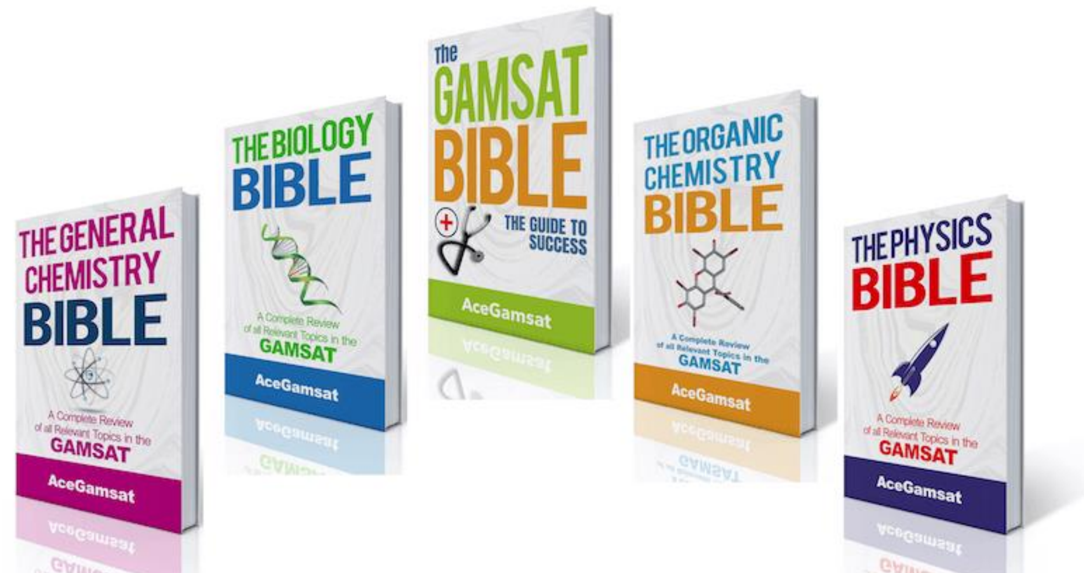

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Question 1
$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$, thus [H+] = 2 x 0.0005 M = 0.001 M
pH = - log $[H^+]$ = - log 10^{-3} = (-1 x -3) x $\log_{10}10$ = 3 x 1 = 3

K_a for bromophenol blue is 1.26 x 10^{-4}
its pK_a = -log K_a = -log (1.26 x 10^{-4}) = -0.1 + 4 = 3.9
Thus the acidic form will exist at pH of 3.

K_a for phenol red is 1.26 x 10^{-8}
its pK_a = -log K_a = -log (1.26 x 10^{-8}) = -0.1 + 8 = 7.9
Thus the acidic form will exist at pH of 3.

The colours of these indicators will both be yellow **(A)**

Question 2
The indicator with the lowest K_a value dissociates the least (least H^+). Phenolphthalein has the lowest K_a out of the options and is therefore the weakest acid. **(D)**

Question 3
K_a of indicator X is 1.00 x 10^{-9}
pK_a = -log K_a = $-\log_{10}10^{-9}$ = 9
When the pH of indicator X is 9, the pH equals the pK_a
Using the equation pH = pK_a + $\log_{10}$ (base/acid)
Thus when pH = pk_a, $\log_{10}$ (base/acid) must equal to zero. For this to occur (base/acid) must equal 1.

Therefore base = acid, and the percentage of Indicator X in basic form is 50%
(C)

Question 4
Initial capacitance of parallel part: 30 + 30 = 60
Thus the total capacitance initially: 1/C = 1/60 + 1/30 = 3/60 = 1/20.
Thus C = 20 μF

After removal of AFC, capacitor B is in series with capacitor D.
1/C = 1/30 + 1/30 = 2/30 = 1/15. Thus C = 15 μF

Effect on total capacitance from removal of AFC (20 changes to 15) is a fall by 5 μF
(B)

Question 5
The charge stored on the left plate of capacitor D must equal the combined charge stored on the right plates of both 'B' and 'F'. Since B and F have equal capacitance and the voltage drop

across each is the same, half the charge must be stored in each. **(A).**

Question 6
By substituting the value of E into the first equation we can find v:

$4\,\cancel{m^2c^4}/3 = \cancel{m^2c^4}/(1-(v^2/c^2))$

$4/3 = 1/(1-(v^2/c^2))$

$1-(v^2/c^2) = 4/3$

$-(v^2/c^2) = (4/3) - 1$

$-(v^2/c^2) = -1/4$

$v^2/c^2 = 1/4$

$v^2 = \sqrt{(c^2/4)}$

$v = c/2$

v = ½ c **(B)**

Question 7
Simply count the number of carbon atoms represented in Figure 1.
There are 27 carbon atoms **(B)**

Question 8
Chiral centers occur when there are four different atoms/groups attached to a carbon atom. Simply count the number of these in Figure 1.
8 **(C)**

Question 9
Simply count the number of hydrogen atoms in Figure 1.
46 **(D)**

Question 10
The rate of reaction depends on the slowest step and the concentration of reactants in that step. **(A)**

Question 11
Three identical units can be seen in Figure 1. Each unit contains an O, and a branched side chain. **(B)**

Question 12
At B, the effective filtration pressure:
= (60 + 15) – (10 + 30)
= 75 – 40

= 35 mmHg **(D)**

Question 13
At A, the effective filtration pressure:
= (95 + 10) – (73 + 30)
= 105 – 103
= 2 mmHg

The effective filtration pressure drives fluid from the plasma into the interstitial fluid. At the same time the differences in hydrostatic pressure in the vessel (95 – 60) pushes fluids in the vessels in the general direction from A to B. **(B)**

Question 14
Divide 4.8×10^4 by 6×10^3 to give 8. Thus eight half-lives have passed. The fraction of the original atoms remaining is thus $(1/2)^8 = 1/256$ **(B)**

Question 15
8 units of X decays to 4 units after 10 minutes, 2 to units after 20 minutes, to 1 unit after 30 minutes, and to 0.5 units after 40 minutes.

1 unit of Y decays to 0.5 units after 40 minutes.

Thus, after 40 minutes, the number of atoms left of C equals the number of atoms left of H. **(B)**

Question 16
$N = N_o \times e^{-\lambda t}$

$N / N_o = e^{-\lambda t}$

$½ = e^{-0.03\,t}$

$2 = e^{0.03\,t}$

$\ln 2 = 0.03\,t$

$0.69 = 0.03\,t$

$t = 0.69 / 0.03 = 69 / 3 = 23$

Half life of compound X is 23 years **(B)**

Question 17
Weight of timber = weight of water dispersed
$V_{timber} + \rho_{timber} \times g = V_{timber\ submerged} \times \rho_{water} \times g$
$4 \times 0.4 \times 0.2 \times \rho \times g = 3.6 \times 0.4 \times 0.2 \times 1000 \times g$
$\rho = 3600 / 4$
$\rho = 900$ **(B)**

Question 18
Weight of timber + weight of m = weight of water displaced
4 x 0.4 x 0.2 x 800 x g + mg = 4 x 0.4 x 0.2 x 1000 x g
256 g + mg = 32 g
mg = 320 g – 256 g
m~~g~~ = 64 ~~g~~
m = 64 kg **(C)**

Question 19
A quick and simple method involves the use of the specific gravity equation.

Specific gravity = density of ice / density of sea water

SG = 917/1024

= 0.896

Therefore 89.6% is submerged in water, and 10.4% is above the surface of the water. **(C)**

Question 20
Dimensions are M for mass, L for length, T for time.
Since F = ma, the dimensions of F are MLT^{-2}. The dimension of s is L. Thus dimensions of K is:

F/s = MLT^{-2} / L = MT^{-2}. **(A)**

Question 21
The two equations are written as redox. One with electron-gain and one with electron-loss.
Thus E° values add together:

E° = 0.601 + 0.399 = 1

There are two electrons in the equation so n = 2.

F = 96.5 KJ = 96500 J

Using the equation ΔG° = -nFE° we get:

ΔG° = - 2 x 96500 J x 1
ΔG° = -193000 J **(D)**

Question 22
The reaction remains the same in each half-cell, but is reversed during electrolysis **(B)**

Question 23
Use F = ma to give 6 = 6a, thus a = a
Now use:
$v^2 = u^2 + 2as$
$v^2 = 0 + 2 \times 1 \times 10$
$v^2 = 20$
$v = 4.47 \approx 4.5$ **(D)**

Question 24
Consider the motion of the apple where:
u = – 6
a = – 10
t = 10

$s = ut + 1/2at^2$
$s = -6 \times 10 + \frac{1}{2} \times -10 \times 10^2$
$s = -60 + (-5 \times 100)$
$s = -60 - 500$
$s = -560$

Therefore the apple drops 560 m. **(B)**

Question 25
The cannonball is projected horizontally, thus the initial vertical component of the velocity is zero. The initial horizontal component must be V and the value of the horizontal component remains uncharged in the motion. When, after 6 seconds, the direction of the velocity is 45° below the horizontal, the vertical component of the velocity must be equal to the horizontal component.

Consider the vertical component
u = 0
t = 6
a = – 10
v = -V

Using v = u + at, we get:
-V = 0 + (– 60)
V = 60 **(A)**

Question 26
The component of the weight down the slope is:
mg sinθ = 5 x 10 x sin30 = 25

Now use F = ma along the slope to give:
25 = 5a
a = 5

Then use:
$s = ut + 1/2at^2$
$s = 0 + 1/2 \times 5 \times 4^2$
s = 1/2 x 5 x 16
s = 40 **(B)**

Question 27
If Mg^{2+} = s, then $[PO_4^{3-}]$ = 2s/3

$K_{sp} = [Ca^{2+}]^3 \times [PO_4^{3-}]^2$

$K_{sp} = (s)^3 \times (2s/3)^2$

$K_{sp} = s^3 \times 4s^2/9$

$K_{sp} = 4s^5/9$ **(D)**

Question 28
Acidic protons will be removed in alkaline solutions. Glutamic acid has two (COOH) carboxylic acid groups and will produce a total charge of 2-. **(A)**

Question 29
Glycine's a-carbon is connected to two H atoms. Therefore it is achiral and cannot form isomers. There is no mixture of isomers and a racemic mixture cannot be produced. **(B)**

Question 30
Entropy is a measure of disorder. All products and reactants are gases. Three moles of gaseous reactants become two moles of products. Disorder decreases and thus entropy decreases. **(B)**

Question 31
$\Delta G° > 0$ – non-spontaneous
$\Delta G° < 0$ – spontaneous
$\Delta G° = 0$ – in equilibrium

Therefore key is **(B)**

Question 32
Both cases show that when heat is applied the reaction proceeds further to the right because: $1.31 \times 10^{-6} > 1.6 \times 10^{-8}$ and $2.4 \times 10^{-5} > 2.3 \times 10^{-5}$.

When considering Le Chatelier's principle, 'heat' must be on the left side of the equation. Both reactions are endothermic. **(C)**

Question 33
$[H_2] = K_{eq} [H_20] / [CO]$

$[H_2] = (5 \times 10^{-7}) \times (3 \times 10^{-1}) / 1.5 \times 10^{-2}$

$[H_2] = 15 \times 10^{-8} / 1.5 \times 10^{-2}$

$[H_2] = 15 \times 10^{-8} / 15 \times 10^{-3}$

$[H_2] = 1 \times 10^{-5}$ **(A)**

Question 34
A catalyst only affects a reaction by decreasing the activation energy of both the forward and reverse reaction. **(A)**

Question 35
The volume of the float is given as 40 cm^3.
This needs to be converted to m^3.
There are 100 or 10^2 cm in a m.
Therefore, there will be $(10^2)^3$ or 10^6 cubic cm in a cubic m.

Consider the forces on the float and allow the tension on the rope to be T.

The downward gravitational force on the float (weight) is:
$F_d = mg = V_dg = (40 \times 10^{-6}) \times 90 \times 10 = 0.036$

The upward force from the water = mass of water displaces x g

$F_u = Vd_wg = (40 \times 10^{-6}) \times 1000 \times 10 = 0.4$

Since the float is snagged underwater, the upward force must equal the downward forces (tension of rope + weight of float)
Thus,
$T + 0.036 = 0.4$
$T = 0.364$ N **(B)**

Question 36
Whilst floating, the weight of the object is equal to the weight of the water it displaces (below the level of the surface of water).

Let V cm^3 = volume of float below surface level of water
weight of object = weight of water displaced by object
$(40 \times 10^{-6}) \times 90 \times 10 = (V \times 10^{-6}) \times 1000 \times 10$
$0.036 = V \times 10^{-6} \times 10000$
$V = 3.6\ cm^3$

As a percentage of its volume, it is 3.6 / 40 x 100 or 9% under water
Thus 91% of its volume will be above the surface of the water. **(D)**

Question 37
$\ln N_t/N_o = -kt$

$\ln (1.906/2) = -k \times 2$
Let x be the amount remaining four years from the beginning.
$\ln (x/2) = -k \times 4$

Thus, $[\ln (x/2) / \ln (1.906/2)] = 2$
$\ln (x/2) = 2 \times \ln 0.953$
$\ln (x/2) = \ln (0.953)^2$

Now, $x/2 = (0.953)^2 = 0.908$
$x = 1.816$ **(B)**

Question 38
Base is 9 single-bonded carbon chain with methyl groups attached at carbon 3 and 6, and ethyl group attached at carbon 4. **(D)**

Question 39
Longest chain containing double bond is heptadiene. Lowest numbers (1 and 3) indicate counting from right. Propyl group at carbon 4. **(B)**

Question 40
Major functional group is the C=O group. This will take position 1, thus compound is a ketone. The diethyl is at position 2 and 3. **(D)**

Question 41
The parent is a 7 carbon chain. The double bonds are at positions 1 and 5 counting from right to left. Chlorine is at 5 and dibromo is at 1 and 7. **(A)**

Question 42
The double bond is assigned 1 and 2 with the rotation such that other prefixes achieve the lowest numbers. Clockwise rotation = lowest numbers. **(C)**

Question 43
The double bonded oxygen has precedence over the OH. It is a ketone and counting starts form the left. The 5 carbon chain has OH and methyl at carbon 4. **(B)**

Question 44
$K_s = [Ca^{2+}] \times [Cl^-]^2$
$1210 = x(2x)^2$
$1210 = 4x^3$
$302.5 = x^3$
$x = 6.7129$

Since 1 mol of $CaCl_2$ gives 1 mol of Ca^{2+}, the solubility of $CaCl_2$ is 6.7129 mol/L. This is 6.7129 x 111 ≈ 745 g/L. **(B)**

Question 45
At the greatest height $V_y = 0$. For the vertical motion;
$V_y = V_o \sin\theta - gt$
$0 = 80 \sin 30° - 10t$
$10t = 40$
$t = 4$

The horizontal component of the velocity remains constant throughout. Thus the total velocity at the greatest height is the horizontal component.

$80 \cos 30° = 69.6$ m/s **(A)**

Question 46

$$\frac{n}{V} = \frac{P}{RT}$$
$$\frac{nM}{V} = \frac{PM}{RT}$$

Where M is the molar mass of CO_2 (12 + 16 + 16) = 44

$$d = \frac{M}{V} = \frac{PM}{nRT} = \frac{44 \times 1}{1 \times 0.0821 \times 400} = \frac{44}{8.21 \times 4}$$
$$= \frac{44}{32.84}$$
$$= 1.3 g/L$$
(A)

Question 47
Only 0.175 M $KClO_3$ has an osmolarity (0.35) higher than that of 0.1 M $CaCl_2$ (0.3). **(C)**

Question 48
All mechanisms are possible for the passage of molecules through the cell membrane. **(D)**

Question 49
If one number is even and the other is odd, their differences must be odd.

The difference between the atomic number and the mass number is the number of neutrons in the nucleus.

If the mass number is odd, the nucleus will exhibit NMR regardless of the atomic number and thus regardless of the difference between the atomic number and the mass number. In this case the number of neutrons could be odd or even, so it is not true to say that the number of neutrons is always even or always odd.

If the mass number is even, NMR shows only for those nuclei that have an odd atomic number is. Therefore the number of neutrons is odd if the mass number is even. **(D)**

Question 50
${}_1^1H$ and ${}_1^3H$ have odd mass numbers and will exhibit NMR. ${}_1^2H$ has an even mass number and an odd atomic number and will also exhibit NMR. **(D)**

Question 51
$C = K_H \,.\, P$
$1.32 \times 10^{-3} = K_H \,.\, 1$
$K_H = 1.32 \times 10^{-3}$
when $P = 0.6$,
$C = K_H \,.\, P$
$C = 1.32 \times 10^{-3} \times 0.6$
$C = 7.92 \times 10^{-4}$ mol / L **(B)**

Question 52
0.3 mol ammonia in ¾ L of water makes NH_4^+ and OH^-
$[NH_4^+] = [OH^-] = 0.4$ mol / L
$K_{sp} = [0.4][0.4]$
$K_{sp} = 0.16$ **(D)**

Question 53
The two groups that need to be removed come from adjacent carbons.
Coming from carbon 1 and 2 will give:

$CH_3 – CH_2 – CH_2 – CH = CH_2$

Coming from carbon 2 and 3 will give:

$CH_3 – CH_2 – CH = CH – CH_3$

In the first product there is only 1 form because of the CH_2 attachment to the double bond.

The second product can exist as cis/trans (2 products)

KBr and H_2O

Total = 5 products **(C)**

Question 54
Counting from the side that is closest to the OH, elimination can only occur between carbons 2 and 3.

Double bond is formed between carbons 2 and 3 due to elimination reaction. **(D)**

Question 55
During an elimination reaction, H is removed from adjacent carbons to the leaving group. C is the only possible product out of the given options. **(C)**