Spacecraft design

1 Question 1

0 out of 10 points

1 

1 Indicate which functions typically are provided for by the spacecraft (S/C or SC) bus.
Answer

1 Selected Answers:
2 ✗ Launch the payload in to orbit
3 ☑ Provide electrical power
4 ☑ Provide navigation
5 ✗ Operate the satellite
6 ☑ Provide attitude control
7
8 Correct Answers:
9 ☑ Provide electrical power
10 ☑ Provide navigation
11 ☑ Provide attitude control
12
13 Response Feedback:
14 Wrong! A list of typical bus functions to be accomplished can be found in SMAD, page 303 or in Table 10 on page 50 of reader A1 (old reader: page 123 and 126 of Reader B).
You can also visit our web pages:
S/C functional design

2 Question 2

0 out of 0 points

1 

1 Have you read/studied our web pages related to S/C engineering?
Answer

1 Selected Answer:
2 ✗ False
3 Correct Answer:
4 ☑ True
5 Response Feedback:
6 If not, why don't you just have a peek? S/C engineering

Our S/C engineering pages provide further links to spacecraft requirements, configuration design, functional design, configuration design, estimation of mass, power, cost, etc., budgeting and producing a design description.
Consider bookmarking the link to S/C engineering.

3 Question 3

0 out of 10 points

1

1 You are designing an Earth Observation (EO) or Remote Sensing (RS) satellite. You have found in literature the following mass values for a range of EO/RS satellites:
2 Payload mass (kg) ; Total mass (kg)
3 1 ; 410.1 ; 1000
4 2 ; 184.5 ; 500
5 3 ; 91.5 ; 300
6 4 ; 358.8 ; 1200
7 Determine the average payload mass % and the SSD (Sample Standard Deviation).
Answer

1 Selected Answer:
2 ✗ 34.6% ; 6.5%
3 Correct Answer:
4 ✓ 34.6% ; 5.4%
5 Response Feedback:
6 You are not correct. Reconsider the steps that you have made.
Do you know that some actual % data can be found in SMAD, page 896, Table A-2, Remote sensing satellites.

4 Question 4

0 out of 10 points

1

1 A kick stage has a propellant mass of 130 kg. What would be a most likely estimate (MLE) for the kick stage dry mass (in kg) based on the information given in **Reader A1, page 37** (old Reader: **Reader B, page 140**)?
Answer

1 Selected Answer:
2 ✗ 150
3 Correct Answer:
4 ✓ 22.75 ± 0.01
5 Response Feedback:
6 Your answer is not right. On **page 37 of Reader A1** (old Reader: **page 140 of Reader B)** it is given that the total kick stage mass is in the range of 1.1 to 1.25 times the kick propellant mass. Since the mass of the kick stage equals tot the summation of the kick propellant mass and the kick dry mass, the average of the kick dry mass can be calculated. Please realize that the values given on **page 37 of Reader A1** (old Reader: **page 140 of Reader B**) are only as good as the underlying data.

5 Question 5

0 out of 10 points

1

1 Using the data on propulsion system mass from the first table given on **page 111 of Reader A1** (old reader: **page 155 of Reader B**), you are asked to come up with a (percentage) value for the average and for the SSD (average; SSD).
Answer

1 Selected Answer:
2 ✗ 2.7% ; 1.0%
3 Correct Answer:
4 ✓ 5.1% ; 2.5%
5 Response Feedback:
6 Average percentage is the sum of the percentages for 4 systems divided by 4. This gives an average percentage of 5.1%. The tricky part is to notice that not all satellites are equipped with a propulsion system. In the table this is indicated by a zero percent value. Therefore all satellites with a zero percentage value for the propulsion system should not be taken into account in the determination of realistic percentage values. More information about SSD can be found in the **Reader** of for example on Wikepedia.

6 Question 6

0 out of 10 points

1

1 Spacecraft dry mass is $0.7*10^3$ kg. Using the data for NASA's mainline S/C given in **Figure 10 on page 41 of Reader A1** (old Reader: **page 143 of Reader B**), you are asked to come up with a first estimate of the total spacecraft cost (in M$ of the fiscal year 1996, FY96).
Answer

1 Selected Answer:
2 ✗ 0.25
3 Correct Answer:
4 ✓ 186.0 ± 25
5 Response Feedback:
6 The answer is not correct. Using the trend line for NASA's main S/C, you can find the S/C cost per unit mass in FY96. Multiplying this value with the given dry mass of the spacecraft gives you a first estimate of your total spacecraft cost in the fiscal year 1996. Note that a reading error is taken into account, therefore the answer can have a deviation of 25 M$ (FY96).

7 Question 7

5 out of 5 points

1

1 The standard deviation given on pages 894, 895, and 896 in SMAD is the so-called sample standard deviation or the unbiassed standard deviation.
Answer

1 Selected Answer:
2 ✅ True
3 Correct Answer:
4 ✅ True
5 Response Feedback:
6 You are correct. For further info, see the **reader A1** or e.g. Wikepedia.

8 Question 8

0 out of 10 points

1

1 You have tabulated mass data of 4 spacecraft belonging to one and the same class. S/C mass is 1000 kg, 2000 kg, 500 kg & 1500 kg, respectively. Average S/C mass is 1250 kg. What is the sample standard deviation (in kg) for the S/C mass?
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ 645.5
5 Answer range +/-
6 5.0 (640.5 - 650.5)
7 Response Feedback:
8 Your answer is wrong! The sample standard deviation follows from the expression for the standard deviation (unbiased one) from statistics. Your calculations should lead to a sample standard deviation of 645.5 kg. When should we use the biased standard deviation? See for instance Wikepedia.

9 Question 9

0 out of 10 points

1

1 You have estimated a vehicle mass of 800 kg with an SSD of 160 kg. Assuming that vehicle mass is gaussian (normally) distributed, determine the range for vehicle mass that encompasses 95% of all possible vehicle masses.
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ 480-1120 kg
5 Response Feedback:
6 Your answer is incorrect. Information on this type of distribution can be found in the **Reader A1** or on internet, e.g. Wikepedia.

10 Question 10

0 out of 10 points

1

1 We are designing a GEO telecommunications satelllite to carry a payload requiring 1500 W of electrical power. Using the data given in **Table A.4 on page 110 of Reader A1** (old reader: page 156 of reader B) you are asked to determine the total (electric) load in W for this spacecraft.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1938 W
5 Response Feedback:
6 That is not the right answer. Consider determining the average percentage of the communications payload power to total power (electrical load) first. This value equals about 77.4% of the total load. Dividing the given payload power of 1500W by 0.774 than gives the total load for this S/C. The correct value is 1938W.

11 Question 11

0 out of 10 points

1

1 You have estimated a S/C mass of 1820 kg. Using **Table 10-28 on page 337 of SMAD** determine for this S/C the linear dimension and the mass moment of inertia.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 3.05 m and 2713 kg-m^2
5 Response Feedback:
6 Y9our anser is not correct. Have another look at **Table 10-28 on page 337 of SMAD**.
Note that the linear dimension value of 2.63 m and the MMOI of 2821 kg-m^2 are exact data for a cubic shaped vehicle as indicated on **page 47 of Reader A1** (old Reader: page 141 of Reader B).

12 Question 12

0 out of 10 points

1

1 You have estimated a S/C mass of 1820 kg. Assuming a homogenous mass distribution, a mass density of 100 kg/m^3, and a cylindrical S/C of diameter 2.5 m, you are asked to determine the MMOI about the cylinder axis.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1400 kg/m^2
5 Response Feedback:
6 The answer you gave is not correct. Have a closer look at the relations given in **Figure 11-39 on page 482 of SMAD** or in the **Reader A1, page 146**. Notice that the MMOI about the cylinder axis equals to half times the mass times the radius of the cylinder squared. This than gives a MMOI of 0.5 x 1820 * 1.25^2 = 1.4 x 10^3 kg-m^2.

13 Question 13
0 out of 10 points

1

1 Consider a flat plate at a distance of 1 Astronomical Unit (AU) from the Sun. The front side of the panel is facing the Sun with the solar radiation normal to the panel. The solar intensity at 1 AU is S = 1371 W/m^2. Given that the front side of the plate is painted white with a solar absorbtivity of 0.15 and an IR emissivity of 0.8 and the back side is painted black with an IR absorbtivity of 0.9 and that the plate has a uniform temperature, you are asked to determine for this panel the equilibrium temperature (expressed in K) in case we have only heat transfer through radiation and there is no heat dissipated in the plate. Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 214
5 Answer range +/-
6 2 (212 - 216)
7 Response Feedback:
8 Study the example problem as discussed on **page 59 Reader A1**.
Setting the area of the front side of the panel equal to A, we find for the heat Q absorbed (subscript a) per unit time by the front side (subscript f): $Q_{a,f}$ = 0.15 * 1371 * A
For the heat emitted (subscript e) by the front and back side (subscript b)of the panel we find: $Q_{e,f}$ = 0.8 sT^4 A and $Q_{e,b}$ = 0.9 sT^4 A
For steady state conditions to occur, the heat absorbed must balance the heat emitted. We get: $Q_{a,f} = Q_{e,f} + Q_{e,b}$ => 0.15 x 1371 x A = (0.8 + 0.9) sT^4 A
Filling in numbers and dividing both sides by A we get an expression with one unknown (T). Solving for T gives a temperature of 214 K.
Note that a_{IR} is e_{IR}.

14 Question 14
0 out of 10 points

1

1 The EPS of a spacecraft is required to produce in total 8 kW of electrical power in low Mars orbit. You are considering the use of a solar photovoltaic system using solar panels with an electrical power density of 150 W/m^2 at 1 AU from the Sun. Calculate the area of the solar array needed to produce the required total power.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 123.8 m^2
5 Response Feedback:
6 First we need to determine the electrical power that the solar array can deliver at Mars. For this we need to know the distance of Mars to the Sun. This distance can be taken from SSE, Table 2.5 (page 37). It follows a distance of 1.524 AU. The power density of the solar array than is 150 W/m^2 / (1.524)2 = 64.6 W/m^2. Given the total power requirement of 8 kW, we find a solar array area of 123.8 m^2.

15 Question 15

0 out of 10 points

1

1 Calculate the force (in microNewton due to solar radiation on a spacecraft at 1 AU from the Sun (I_s = 1400 w/m^2). The spacecraft surface perpendical to the Solar radiation is equal to 5 m^2, and has a reflectivity K (or r) equal to 0.5.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 35
5 Answer range +/-
6 2 (33 - 37)
7 Response Feedback:
8 Your answer is incorrect. See for more information on the force due to solar radiation **page 88 Reader A1**.

16 Question 16

0 out of 10 points

1

1 A S/C has to perform various manouevres using a rocket propulsion system. Below the manouevres are given in terms of delta-V (Dv) and the specific impulse (I_{sp}) of the propulsion system used:
2 - Injection into target orbit: Dv = 1000 m/s, I_{sp} = 300 s
3 - Orbit maintenance: Dv = 200 m/s, I_{sp} = 200 s
4 - De-orbit at EOL: Dv = 250 m/s, I_{sp} = 200 s
5 You have estimated a S/C dry mass of 500 kg. Calculate the initial vehicle mass (dry mass + propellant load). You may assume that g_o = 10m/s^2.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 874 kg
5 Response Feedback:
6 Your answer is incorrect. You should use the rocket equation (also referred to as Tsiolkowsky equation), which can be found on **page 36 of Reader A1** (old reader: page 145 of Reader B). Do realize that the propellant exhaust velocity equals I_{sp} times the gravitational acceleration (at sea level), M_o is the initial mass befor the maneuver starts and M is the mass after the maneuver ends.Dv = 450 m/s = 2000 m/s x ln($M_{o,1}$/ M_e). Since M_e is given, it follows for $M_{o,1}$ = 1.3 x M_e = 626.2 kg

Dv = 1000 m/s = 3000 m/s * ln($M_{o,2}$/$M_{o,1}$). Using the above calculated value for $M_{o,1}$, we find $M_{o,2}$ = 1.4 x $M_{o,1}$ = 873.9 kg.
Note that $M_{o,1}$ is identical to $M_{e,2}$ and that $M_{e,1}$ here is set equal to M_e.

17 Question 17
0 out of 5 points

1

1 What is the correct unit for the angular momentum H, see **Reader A1, page 73**.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓

18 Question 18
0 out of 10 points

1

1 A satellite experiences a constant disturbance torque about one of its principal axis of 0.001 Nm. MMOI about this axis is 2000 kg-m^2. Calculate the angle (in arcsec; accurate up to 1 digit behind the decimal sign) over which the satellite will rotate over a 10 second period.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 5.16
5 Answer range +/-
6 0.05 (5.11 - 5.21)
7 Response Feedback:
8 Using relation 45 (Reader A1, page 74) we find that the spacecraft experiences an angular acceleration of 0.001 Nm/2000 kg-m^2 = 5 x 10^{-7} rad/s^2. Hence over a 10 second period, the vehicle rotates over an angle of 2.5 x 10-5 rad or 0.0014 deg. This is equal to 0.0014 x 3600 arcsec = 5.16 arcsec.

19 Question 19

0 out of 10 points

1

1 You are designing the C&DH system of a spacecraft for a mobile communications system. The spacecraft is required to allow for 1000 voice channels at any one time. For housekeeping the spacecraft is equipped with 400 temperature sensors, 10 pressure sensors, 250 voltage and current sensors and 40 status sensors. The following data rates are applicable:
   - temperature sensors: 10 bps
   - pressure sensors: 16 bits an an average frequency of 0.1 Hz
   - voltage and current sensors: 12 bits at an average measurement frequency of 2 Hz
   - status sensors: 2 bits at an average frequency of 0.2 Hz.
2 Using the information from **section 4.6 from Reader A1**, you are asked to calculate for this spacecraft the total signal data rate produced (in kbps) and determine the storage space needed in case this data has to be stored on board of the spacecraft for the duration of 1 hour. Your answer should be accurate up to two digits behind the decimal point.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 64026.016
5 Answer range +/-
6 0.020 (64025.996 - 64026.036)
7 Response Feedback:
8 The following data rates can be calculated:
Mobile communications: 1000 x 64 kbps = 64 Mbps
Temperature sensors: 400 x 10 bps = 4 kbps
Pressure sensors: 10 x 16 x 0.1 = 16 bps (0.1 hz means 1 measurement every 10 seconds)
Voltage and current sensors: 250 x 12 x 2 = 6 kbps
Status sensors: 40 x 2 x 0.2 = 0.016 kbps

20 Question 20

0 out of 10 points

1

1 You have designed a solar wing of size 3 m x 6.6 m (height x length) with an average mass of 2.5 kg/m^2. Determine the MMOI of this wing about an axis perpendicular to the array face at a distance of 3.3 m from the edge (shortest side) of the solar array.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 2373 kg-m^2
5 Response Feedback:
6 Your answer is not correct. Study **page 102 of Reader A1** in more detail. You may also consider the **table 10-29 from SMAD**.
Panel area is 3 x 6.6 = 19.8 m^2. Panel mass is 49.5 kg.
I about axis through com is 1/12 x 49.5 x (3^2 + 6.6^2) = 216.8 kg-m^2.

Using Steiner and taking L_a as 6.6/2 + 3.3 = 6.6m gives a MMOI of 49.5 x 6.6^2 + 216.8 = 2373 kg-m^2

Thermal Test

21 Question 1

1 out of 1 points

1

1 In failure mode, equipment dissipation is:
Answer

1 Selected Answer:
2 ✅ 0
3 Correct Answer:
4 ✅ 0
5 Answer range +/-
6 0 (0 - 0)

22 Question 2

0 out of 1 points

1

1 If you know that the solar constant in Earth Orbit is 1371 W/m^2 and that the planet Mercury has a distance to the sun of 0.4 AU.
2
3 The Solar intensity in an orbit around Mercury is ...
Answer

1 Selected Answer:
2 ❌ 5484 W/m^2
3 Correct Answer:
4 ✅ 8569 W/m^2
5 Response Feedback:
6 The way to compute this answer is to use relative numbers: 1371 / 0.4^2 gives 8569 W/m^2

23 Question 3

0 out of 1 points

1

1 The hot acceptance temperature of a component is:
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ The temperature, which the component must not exceed
5 Response Feedback:
6 This information can be found in section 11.5 of SMAD

24 Question 4

0.5 out of 0.5 points

1 Thermal Control would be impossible if Spacecraft were black bodies, except perhaps by varying the internal heat dissipation
Answer

Selected Answer:
☑ True
Correct Answer:
☑ True
Response Feedback:
See section 11.3 of SSE

25 Question 5
0.5 out of 0.5 points

1 Albedo is unitless
Answer

Selected Answer:
☑ True
Correct Answer:
☑ True

26 Question 6
0 out of 1 points

1 Albedo tends to...
Answer

Selected Answer:
✗ increase with altitude
Correct Answer:
☑ decrease with altitude
Response Feedback:
Study the section 11.2.1 from the book SSE

27 Question 7
0 out of 0.67 points

1 For which one of the following may Albedo be neglected?
Answer

Selected Answer:
✗ High Earth Orbits
Correct Answer:
☑ GEO
Response Feedback:
See section 11.5.5 of SMAD

28 Question 8
0 out of 2 points

1

1 A radiator plate, which has an area of 2 $m^{2,}$ is coated with OSRs (α_s = 0.09). The radiator is illuminated by the sun perpendicularly (S = 1350 W/ m^2) and dissipates 75 W by its electronics.
2 What is the total heat input of the plate? [W]
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 318
5 Answer range +/-
6 1 (317 - 319)
7 Response Feedback:
8 Heat input = S * Area *α_s + Heat dissipation

29 Question 9
0 out of 1 points

1

1 The insulating performance of a thermal blanket is mostly expressed as an effective emissivity, and not as an effective conductivity.
2
3 This is because ...
Answer

1 Selected Answer:
2 ✗ Most heat transfers in space are modelled as radiations
3 Correct Answer:
4 ✓ The major heat leak through a blanket is radiative

30 Question 10
1 out of 1 points

1

1 A radiator...
Answer

1 Selected Answer:
2 ✓ rejects internally generated waste heat
3 Correct Answer:
4 ✓ rejects internally generated waste heat

31 Question 11
0 out of 1 points

1

1 A plate with dimensions 3.5 x 10 cm is in deep space. The plate has a 2 mil Aluminized Teflon coating. The temperature of the plate is 114 degrees Centigrade.

2 Using the data given in the table 11-46 of SMAD calulate how much heat (in Joules) the aforementioned plate will radiate?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 5.876
5 Answer range +/-
6 0.500 (5.376 - 6.376)
7 Response Feedback:
8 Table 11-46 of SMAD gives the properties of the surface finish. To calculate the heat, use equation 11-11 in SMAD.

Structures

32 Question 1

0 out of 1 points

1

1 Calculate the bandwidth (in Hz) of a launcher with random vibrations having a random acceleration of 10 g_{rms} and a Power Spectral Denstiy (PSD) of 0.2 g^2/Hz
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 500
5 Response Feedback:
6 Study the slides 27 and 28 from the structures section (see hand-out) Read also SSE section 2.2.2. with special attention to the text relating to the figure 2.2 or SMAD, section 11.6 with special attention to the text relating to figure 11-26.

33 Question 2

0 out of 1 points

1

1 Calculate the area moment of interia 'I' (in m^4 !!) of a cylindrical structure with radius 2m and wall thickness 0.5mm
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.0126 m^4

34 Question 3

0.5 out of 0.5 points

1

1 A structure is stiff when the force to displacement ratio is high
Answer

1 Selected Answer:
2 ✓ True
3 Correct Answer:
4 ✓ True

35 Question 4

0 out of 0.67 points

1

1 What does the acronym SPL in the structures text of SMAD stand for?
Answer

1 Selected Answer:
2 ✗ Static pressure Load
3 Correct Answer:
4 ✓ Sound Pressure level
5 Response Feedback:
6 See page 742 of SMAD.

36 Question 5

0.5 out of 0.5 points

1

1 An octave band is the interval between a given center frequency of a certain frequency band and another center frequency of an adjacent frequency band, equal to half or double the given center frequency.
Answer

1 Selected Answer:
2 ✓ True
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 OK. So if we have a frequency band with a center frequency of 100 Hz, than 50 Hz and 200 Hz are both one octave away from the original frequency, whereas 25 and 400 Hz are two octaves away.

37 Question 6

0 out of 1 points

1

1 A spherical titanium propellant tank with an internal volume of 2 m^3 is subjected to an internal pressure of 20 bar. Calculate for this tank the minimum tank wall thickness (in mm) required given that we intend to proof test all tanks produced before flying them. For the material properties, you may consult SMAD, table 11-52.Your answer should be correct up to two digits behind the decimal point.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1.09
5 Answer range +/-
6 0.01 (1.08 - 1.10)
7 Response Feedback:
8 Use SMAD, relation 11-55, while taking into account a safety factor from the Table 11-54. From the tank volume follows a tank diameter of 0.782 m. From the table 11-52 the ultimate strength of titanium is 900 E6 N/ m^2. From the Table 11-54, we obtain a design factor of safety of 1.25. It follows for the thickness of the tank material of 1.086 mm.

38 Question 7
0 out of 1 points

1 

1 Calculate the Natural Frequency (Hz) of a simple one-degree-of-freedom Mass-Spring system

with:

k = $4*10^6$ N/m
m = 5 kg

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 142.35
5 Answer range +/-
6 1.00 (141.35 - 143.35)
7 Response Feedback:
8 Study the slides on natural frequencies as contained in the reader A1 (structures section), see for instance slides 37, 38, 66 and 67. Also study section 11.6 from SMAD with special attention to the text relating to the figure 11-42.

39 Question 8
0 out of 0.67 points

1 

1 What is definition of stiffness?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Force divided by the displacement
5 Response Feedback:
6 Definition

40 Question 9
0 out of 0.5 points

1
1 Young's modulus or modulus of elasticity is important for buckling
Answer
1 Selected Answer:
2 ✗ False
3 Correct Answer:
4 ✓ True

41 Question 10
0.67 out of 0.67 points

1
1 Factors of Safety are defined ....
Answer
1 Selected Answer:
2 ✓ to cover uncertainties
3 Correct Answer:
4 ✓ to cover uncertainties

42 Question 11
0.5 out of 0.5 points

1
1 In designing a structure, launch loads are dominant
Answer
1 Selected Answer:
2 ✓ True
3 Correct Answer:
4 ✓ True

43 Question 12
0 out of 0.5 points

1

1 In designing a cylindrical pressure vessel with spherical heads, the required wall thickness of the cylindrical part exceeds that of the spherical parts.
Answer

1 Selected Answer:
2 ✗ False
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SMAD page 480/481 or 714. For a cylinder the hoop stress is twice the meridional stress. This than requires a larger thickness to prevent failure.

44 Question 13

0 out of 1 points

1

1 For a rocket launcher you have determined that a Sound Pressure Level (SPL) of 137 dB is induced in the octave band centered about 250 Hz. Calculate for this band the SPL in Pa.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 142
5 Answer range +/-
6 1 (141 - 143)
7 Response Feedback:
8 See lecture notes, part structures, slide 18.

45 Question 14

0.67 out of 0.67 points

1

1 What is definition of Margin of Safety (MS, MoS)
Answer

1 Selected Answer:
2 ✓ {Allowable load (stress)} / {design load (stress) multiplied by the factor of safety} - 1
3 Correct Answer:
4 ✓ {Allowable load (stress)} / {design load (stress) multiplied by the factor of safety} - 1
5 Response Feedback:
6 Good job!

46 Question 1
0 out of 1 points

1

1 How many gyroscopes are needed on a satellite (without any other sensors) to fully determine the attitude of the satellite during its lifetime?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ This is not possible
5 Response Feedback:
6 A key characteristic of gyroscopes is drift. In practise this drift requires regular calibration from other sensors (e.g. star tracker). If no other sensors are available, the drift will make gyroscopes unusable.

47 Question 2
0 out of 1 points

1

1 A single-spin satellite, without internal energy dissipation and without external disturbance torques is stable if the rotation axis coincides with (multiple answers possible):
Answer

1 Selected Answers:
2 [None Given]
3 Correct Answers:
4 ✓ The direction of the smallest moment of inertia.
5 ✓ The direction of the largest moment of inertia.
6
7 Response Feedback:
8 Because the case is without internal energy, both the largest and smallest moment of inertia is correct

48 Question 3
0 out of 1.5 points

1

A spherical satellite with a 1m radius is spinning around its z-axis (top-axis) with 50 RPM. The momentum of inertia around the spin axis is 600kg-m^2.

A thruster pair of 10 N each is located outside of the sphere. One thruster is pointing in the negative x-direction and one thruster (on the opposite side of the spacecraft) in the positive x-direction. How long do the thrusters have to burn before the satellite has stopped spinning?
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ 157.1 sec
Response Feedback:
Total angular momentum is:
. (Convert from RPM to rad/s).

The time derivative of the angular momentum is equal to the applied moment:

The time it takes to cancel all angular momentum is thus:

49 Question 4

0 out of 2 points

1

Select all the passive control methodes from the following list (multiple answers possible)
Answer

Selected Answers:
[None Given]
Correct Answers:
✓ Spin stabilization
✓ Dual spin stabilization
✓ Gravity gradient stabilization
✓ Magnetic stabilization

Response Feedback:
See lecture notes A2 page 43

50 Question 5

0 out of 0.5 points

1

Typical attitude control accuracy in case of pure spin stabilization is the same as for dual spin stabilization
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Read the sections 3.4.2 and 3.4.3 of Fortescue, Stark and Swinerd

51 Question 6
0 out of 1 points

1 

1 What is the minimum number of fixed thrusters required for 3-axis independent position and rotation control?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 12

52 Question 7
0 out of 1 points

1 

1 What is the correct unit for the angular momentum H
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ kg-m^2/s

53 Question 8
0 out of 1.5 points

1 

1 For a spacecraft (S/C) in Geostationary Earth Orbit you are asked to calculate the maximum disturbance torque (in microNewton-meter) due to solar radiation. Given:

- Solar flux: 1418 W/m^2
- Solar reflectance factor: 0.5
- Distance between center of (solar) pressure and centre of gravity: 0.1 m
- Surface area receiving sunlight: 5 m^2

2

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 3.5
5 Answer range +/-
6 0.1 (3.4 - 3.6)
7 Response Feedback:
8 Study for instance the Reader A2, pages 31-33. Notice that the angle i does not effect the worst case disturbance torque as the angle i varies over the year. Only for a very short mission it might have some effect.

54 Question 9
0 out of 0.5 points

1 

1 Nutation is the motion of the angular momentum vector caused by external torques.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Def: Nutation is a slight irregular motion (etymologically a "nodding") in the axis of rotation of a largely axially symmetric object, such as a gyroscope or a planet.

55 Question 10
0 out of 0.5 points

1 

1 An electromagnet is an active control method.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See lecture notes A2 page 51 for a list of characteristics of active control methods

56 Question 11
0 out of 1.5 points

1

1 For a spacecraft in circular LEO at altitude 500 km are given the following MMOI:
- About central (cylinder) axis 75000 kg m^2
- About axis perpendicular to the central axis: 150,000 kg m^2

2 Calculate for this vehicle the maximum disturbance torque (in Nm, accurate up to 4 digits behind the decimal sign) as induced by gravity or more specific due to the gradient in the gravity field.
P.s.: This problem was part of the year 2007 exam.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.1378
5 Answer range +/-
6 0.0001 (0.1377 - 0.1379)
7 Response Feedback:
8 Using the relation for the maximum gravity gradien torque, we find:

57 Question 12

0 out of 1 points

1

1 The nadir vector is pointing in the direction of ..
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ The earth

58 Question 13

0 out of 0.5 points

1

1 The combination of a reaction wheel and a double-gimbaled control moment gyro with same initial rotation axis, can deliver control torques around all body axes
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 The reaction wheel can generate a moment around the spin-axis, while the double gimbeled CMG can generate moments around the two axes perpendicular to the spin axis.

59 Question 14

0 out of 1 points

1

1 What type of control law is:
?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ PID-Control
5 Response Feedback:
6 Study for instance the Reader A2, pages 46-51.
You may also consult the problems 6.2 and 6.5 from the Workbook Problems & Solutions, July 2009

Power

60 Question 1

0 out of 0.5 points

1

1 A battery generally is considered a constant voltage source.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct. When connected to a solar array, it is the battery voltage that determines the voltage in the circuit (provided that no other regulation is performed). That the battery voltage varies with the charged state (100% full, 50% full, or other) does not have anything to do with the battery being a constant voltage source or not.

61 Question 2

0 out of 1 points

1

1 In Spacecraft Systems Engineering (SSE), p347-349, various types of regulators are introduced. Which of the functions below are controlled/ regulated by the battery control unit.
Answer

1 Selected Answers:
2 [None Given]
3 Correct Answers:
4 ✓ The charging of the battery
5 ✓ The discharging of the battery
6
7 Response Feedback:
8 Read Spacecraft Systems Engineering, pages 347-349.

62 Question 3

0 out of 0.5 points

1

1 The power output from a solar cell decreases with decreasing cell temperature.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See for instance lecture notes, part A1, page 217.

63 Question 4

0 out of 1 points

1

1 A spacecraft (S/C) is equipped with a solar array (SA) and a battery. To save mass and to keep the system simple and hence reliable, you have opted for an unregulated bus. For this bus, the potential (voltage) is determined by the solar array.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Read SSE section 10.5 and SMAD, section 11.4.4. Give specific attention to SMAD, p. 426.

64 Question 5

0 out of 1 points

1

1 You are designing a solar array for the production of 1000 W at 50 Volt. You are using Si solar cells with a nominal cell voltage of 0.5 Volt at maximum power point and a current of 40 mA/cm^2. Calculate for this array the number of strings needed to produce the required power in case the cell size is 5 square (sq.) centimetre.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 100
5 Answer range +/-
6 1 (99 - 101)
7 Response Feedback:
8 We need 100 cells in series. Each cell produces 200 mA. Current to be produced is 20 amp. This than means that we need 100 strings in parallel.

65 Question 6

0 out of 1 points

1

1 Various types of electric power provision exist. To find out which is the most suitable for the mission at hand, they should be traded. As part of such a trade, you are asked to put the following types of electric power systems in order of increasing suitability (least suitable is #1 and so on) for high power and long duration space missions.
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Batteries
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Fuel cells
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Photovoltaics
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Nuclear
17 ❌ -
18 [None Given]

66 Question 7

0 out of 1 points

1

1 Calculate the total energy (in Whr) that needs to be stored in a battery when this battery has to provide 40 Whr at a DOD of 40% and a battery discharge efficienty of 95%.
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ 105.3
5 Answer range +/-
6 1.0 (104.3 - 106.3)
7 Response Feedback:
8 Divide the energy that needs to be provided by the battery (40 Whr) by the DOD (40%) of the battery.

67 Question 8

0 out of 1 points

1

1 A typical energy source for electrical power generation in space is the Sun. What is the available solar flux (in Watt per square metre) for a spacecraft that is in a circular low Earth orbit (400-1000 km altitude).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1365
5 Answer range +/-
6 65 (1300 - 1430)
7 Response Feedback:
8 See SMAD, p.413 or SSE p.358 or p.330.
9
10 The value of the solar illumination (radiation) intensity (or solar constant) is in the range 1367 +/- 5 W/m^2 (SMAD, p413), 1371 +/- 5 W/m^2 (SSE, p358) at 1 AU (1 AU is the average distance of Earth from the Sun). The difference in the value of the solar constant is because of sunspot activity. For a quick and dirty estimate, sometimes a value of 1.3-1.4kW/m^2 is used.

68 Question 9

0 out of 1 points

1

1 Order the following types of solar cells in order of increasing cell efficiency.
Answer

1 Correct Answer
2 Selected Answer
3 ✓ 1.
4 Thin sheet amorphous silicon
5 ✗ -
6 [None Given]
7 ✓ 2.
8 Silicon (Si)
9 ✗ -
10 [None Given]
11 ✓ 3.
12 Gallium Arsenide (GaAs)
13 ✗ -
14 [None Given]
15 ✓ 4.
16 Multi-junction GaInP/GaAs
17 ✗ -
18 [None Given]
19 Response Feedback:
20 See SMAD, p414 or lecture notes, part A1, p217.

69 Question 10

0 out of 1 points

1

1 You are designing the electric power generation subsystem for a satellite in a 400 km circular Earth orbit. Average power needed during eclipse conditions is 300 W and during sunlit conditions 500 W. You have selected a photovoltaic system with a path efficiency in daylight of 80% and during eclipse of 60%. Determine for this satellite the power to be provided (in kiloWatt) by the solar array.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.945
5 Answer range +/-
6 0.005 (0.940 - 0.950)
7 Response Feedback:
8 Power is calculated using SMAD, relation 11-5. To do this, we first have to determine max. eclipse duration and time in daylight. From SMAD, table "Earth Satellite parameters" follow:
9 - Orbit period: 92.56 min.
10 - Max. eclipse: 36.11 min.
11 Time in daylight follows by subtracting max. eclipse time from orbit period. This gives 92.56-36.11 = 56.45 min.
12 Substituting known values in relation 11-5 gives:
13 P_sa = (300 * 36.11/0.6 + 500 * 56.45/0.8)/56.45 = 945 Watt or 0.945 kW.

70 Question 11

0 out of 1 points

1

1 You have designed an RTG using an isotope fuel with a half life of 45day. This RTG has been designed to provide 1000W at start of mission. End of mission is after 1 year. What is the available power (in Watt) at end of mission?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 3.62 W
5 Response Feedback:
6 See SSE, relation 10.4, p.340.
7 Initial power: 1000W
8 Half life: 45day
9 Mission life: 365day
10 Substitution in relation 10.4 gives:
11 P = 1000W * e^(-0.693 *365day/45day) = 3.62W

71 Question 12

0 out of 1 points

1

1 Calculate the energy (in Whr) that needs to be provided to the battery system given that the system (battery + battery regulators) shall provide to the S/C 100 W for the eclipse duration (20 min.) + an additional 20 W during 5 min. to provide for peak power during sunlit conditions. Battery, BCR (battery charge regulator) and BDR (battery discharge regulator) have an efficiency of 0.95, 0.90 and 0.90, respectively.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 45.4
5 Answer range +/-
6 0.6 (44.8 - 46.0)
7 Response Feedback:
8 The energy (E) that needs to be provided to the battery system can be calculated using:
9 E = (P_ecl * t_ecl + P_peak * t_peak)/(BCR efficiency * battery efficiency * BDR efficiency)

72 Question 13

0 out of 1 points

1

1 You are designing the electric power generation subsystem (EPS) of an Earth satellite with an operational life of 2 years. Average operating power is in the range of 2 kW. Select the best energy source.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Photovoltaics
5 Response Feedback:
6 See amongst others SSE, fig. 10.1 and http://www.lr.tudelft.nl/live/pagina.jsp?id=b4355b1f-d867-4862-bffa-94dd3f11a6e1〈;=en

73 Question 14

0 out of 1 points

1

1 You are designing a solar thermo-electric system in Low Earth Orbit (LEO) to produce 10 kW of electric power for the International Space Station. Calculate the frontal diameter (in meter) of the circular solar dish needed to collect the neccesary solar power in case we have a conversion rate from solar energy to electrical energy of 25% and use only the direct sunlight from the Sun (possible contributions of Earth IR radiation and albedo and other radiation sources is neglected).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 6.11
5 Answer range +/-
6 0.05 (6.06 - 6.16)
7 Response Feedback:
8 To calculate the diameter of the dish, we need the value of the solar illumination (radiation) intensity (or solar constant). This value is in the range 1367 +/- 5 W/m^2 (SMAD, p412), 1371 +/- 5 W/m^2 (F&S, p358) at 1 AU (1 AU is the average distance of Earth from the Sun). The difference in the value of the solar constant is because of sunspot activity. Here we will take a conservative value of 1365W/m^2. To produce 10kW of electric power means that we require 10kW/(25/100 = 25%) = 40kW of input power. This power has to be provided by the dish. To produce 40 kW, we need a frontal area (A) of the dish of 40kW/1.365kW/m^2 = 29.3 m^2. This then gives for the diameter (D) of the dish using A = PI/4*D^2: D = 6.11m

74 Question 15

0 out of 0.5 points

1

1 Battery charge regulation is favourable for battery cycle life.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct. Battery charge regulation can signigicantly increase battery life. In case no battery charge regulation, battery life reported in SMAD should at least be halfed.

75 Question 16

0 out of 1 points

1

1 What are typical percentages of spacecraft bus dry mass that can be attributed to the electrical power subsystem?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 20-40 %
5 Response Feedback:
6 This is 20-40%, see a.o. lecture notes, part A1, page 207. From SMAD, p. 895 and 896, we learn that the average mass percentage is 25-30% with a standard deviation of 3-7%.

76 Question 17
0 out of 0.5 points

1 

1 To start the design of the electric power subsystem we should at least have a power budget.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SMAD, page 332 or lecture notes ae2-S02, part A1, p208.

77 Question 18
0 out of 0.5 points

1 

1 To calculate the required battery capacity (for instance in Whr), we calculate the product of power needed times the duration over which this power is needed and divide this by the product of DOD, charge efficiency and number of batteries.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SMAD p422.

78 Question 19
0 out of 1 points

1

1 You are designing the electric power subsystem of TU-Delfts' Pica launcher. The DC bus of this launcher powers the stage separation systems, stage ignition and controls, and instrumentation during the flight as well as in a the 20 minute period just preceding take-off. Average power usage is 150W and total flight time is 10 min. DC bus voltage is 28 Volt. Determine for this launcher the battery capacity expressed in Ah.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 2.68
5 Answer range +/-
6 0.10 (2.58 - 2.78)
7 Response Feedback:
8 150 w times 0.5 hour is a total energy consumption of 75 Wh. Divided by the bus voltage of 28 Volt, gives a battery capacity of ~2.7 Ah
9
10 Selecting an AgZn battery with an open cell voltage of about 2 volt shows we need 14 cells in series each with the calculated capacity. Given that AgZn batteries have a specific energy of 100 Wh/kg, we find that the battery mass is 0.7 kg.

79 Question 20
0 out of 0.5 points

1

1 A solar cell is a constant voltage source.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False

80 Question 21
0 out of 0.5 points

1

1 Duty cycle (or duty factor) is the ratio of the time that an instrument is operating to the total time.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are incorrect. Study lecture notes part A1, p.208.
7
8 Do realize that it is important to know the duty cycle because it relates to peak and average power in the determination of total energy output. This, in turn, ultimately effects the power supply capacity of the Electric Power Subsystem (EPS), see also fig. 10.20, SSE, p. 353.

81 Question 22
0 out of 0.5 points

1 

1 Peak Power Tracking (PPT) is one way of regulating the power output from a solar array.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SSE, p.347 or SMAD, p.425.

82 Question 23
0 out of 1 points

1 

1 Order the following secondary battery types according to increasing specific energy density
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Nickel-Cadmium (NiCd)
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Nickel-Hydrogen (NiH)
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Lithium-Ion (Li-ion)
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Sodium-Sulfur (NaS)
17 ❌ -
18 [None Given]
19 Response Feedback:
20 Consult SMAD, p.420, SSE p.344, and Reader Part A1., Section Electrical Power generation and more specific the part on batteries.

83 Question 24

0 out of 1 points

1

1 A battery shall provide 40 Whr at a nominal voltage of 16 Volt. What is the cell capacity (in Ahr) in case the nominal cell voltage is 2 Volt.
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ 0.31
5 Answer range +/-
6 0.01 (0.30 - 0.32)
7 Response Feedback:
8 Divide the battery capacity (in Whr) by the product of voltage to be delivered and number of cells.

84 Question 25

0 out of 1 points

1

1 You are designing a nuclear electric powerplant. This system produces 208 kW of electric power at an efficiency of 25%. The excess heat is radiated into space using water filled radiators with a specific mass of 6 kg/square meter. Total heat radiated per sq. meter is 1.2 kW. Determine the total radiator area (in meter squared) that is needed to radiate this heat into space. Select from below the answer you consider closest to the area determined.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 520 m^2
5 Response Feedback:
6 Thermal power produced is 208 kW/0.25 = 832kW
7 Rejected or radiated power is 832kW - 208kW = 624kW/m^2
8 Radiator area is 624/1.2 = 520m^2.

85 Question 26

0 out of 0.5 points

1

1 An external energy source has as disadvantage that the energy it produces varies with the distance to the spacecraft.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 No. It is the energy that arrives at the spacecraft which varies, see SSE, p.358.

86 Question 27

0 out of 1 points

1

1 You are considering the use of the solar panels of the Mars Express vehicle for the Venus Express vehicle. The solar panels of the Mars Express vehicle are designed to deliver 650W when in Mars orbit. Estimate how much power (in Watt) these solar panels will deliver when in Venus orbit.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 2881
5 Answer range +/-
6 10 (2871 - 2891)
7 Response Feedback:
8 See SSE, table 11.2, p.358: 1.91/.431 X 650W = 2881W

87 Question 28
0 out of 0.5 points

1 

1 A battery is 100% efficient.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Energy is lost in storage, charging and discharging. With new cells efficiencies of ~ 90% can be expected, however this decreases with age.

88 Question 29
0 out of 1 points

1 

1 Typical electric power usage levels for spacecraft today are in the range .....
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ A few hundred Watt up to several kWatt
5 Response Feedback:
6 See lecture notes part A1, section on electrical power generation and more specific the introduction.

89 Question 30
0 out of 1 points

1 

1 Order the following heat-to-electricity converters according to increasing conversion efficiency.
Answer

Correct Answer
Selected Answer
✅ 1.
Thermo-element
❌ -
[None Given]
✅ 2.
Thermo-ionic conversion (TIC)
❌ -
[None Given]
✅ 3.
Stirling-based dynamic converter
❌ -
[None Given]
✅ 4.
Rankine-based dynamic converter
❌ -
[None Given]
Response Feedback:
Study the reader A1, section on electrical power generation and more specific the part on nuclear-electric sources.
However, In case you used SMAD the position of the Stirling and Rankine cycle may be interchanged. In that case you may consider your answer also to be correct.
What you should realize though is that different books may give different answers. This may be because some of the data is outdated or that some data is not available to all, etc.. Hope that this question creates some awareness with you.

Command and data handling

90 Question 1

0 out of 1 points

1

In the list below, indicate the functions that belong to the C&DH system
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ On-Board time keeping
- ☑ Command processing
- ☑ Telemetry frame generation

Response Feedback:
You are not correct. Power storage is not a function of the C&DH system, it is a function of the Electrical Power System (EPS).

91 Question 2

0 out of 0.5 points

1

Over a half duplex link, telecommands can be transmitted simultaneously with telemetry reception.
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
☑ False
Response Feedback:
You are wrong, consult the Reader A1, page 250 for for information on simplex, half duplex and duplex links.

92 Question 3

0 out of 0.5 points

1

A watchdog timer is used to make sure that the on-board computer is put into sleep mode when required
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 You're wrong, the watchdog timer is used to reset the on-board computer in case it stops executing its program due to a failure / latch up due to radiation
7 See the Reader A1, p. 263 (old reader A1, p.178) and SMAD p.401

93 Question 4

0 out of 1 points

1

1 An analog signal with a maximum signal frequency of 10kHz has to be converted to a digital signal. What value of the sampling frequency (in kHz) is required at least?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 22
5 Answer range +/-
6 2 (20 - 24)
7 Response Feedback:
8 According to Nyquist's criterium, the sampling frequency must be at least 2.2 times the maximum signal frequency in order to avoid aliasing.
9 For more information consult the Reader A1, section command and data handling, part on sampling an analog signal (old reader A1 p. 172), SMAD p.544, or http://en.wikipedia.org/wiki/Nyquist-Shannon_sampling_theorem
10 or "Digital and Analog Communications Systems", 6th edition, by Leon W. Couch ISBN 0-13-081223-4
11
12 Note: Shannon sampling is not the same as the Shannon limit.

94 Question 5

0 out of 0.5 points

1

1 Voice is an example of an analog signal
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct, human voice is an analog signal. See SMAD p. 544-546

95 Question 6
0 out of 1 points

1

In the following list, indicate which sources are sources for commands
Answer

Selected Answers:
[None Given]
Correct Answers:
☑ Uplink transponder
☑ Hardline test interface

Response Feedback:
You are incorrect, consult for instance the text/slides in the reader on Command & Data Handling, with specific attention to the pages 252 and 253 (old reader A1, p. 162)

96 Question 7
0 out of 0.5 points

1

Two way coherent mode, between the transponder and the groundstation, allows the range or line-of-sight to be measured.
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
☑ True
Response Feedback:
This information is in reader A1 page 249 (old reader A1, p160).

97 Question 8
0 out of 1 points

1

Which of the following command sources has the highest priority during flight?
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
☑ Uplink Transponders
Response Feedback:
You can see this in reader A1, page 251 (old reader A1, p162).

98 Question 9

0 out of 0.5 points

1

1 Carrier tracking can be used to determine the range-rate of the spacecraft with respect to the groundstation
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are wrong, consider the Doppler effect and what causes it.

99 Question 10

0 out of 1 points

1

1 The following steps are required to convert an analog signal to a PEM digital one. Number them in the correct sequence. 1 is the first step and 4 is the last step.
Answer

1 Correct Answer
2 Selected Answer
3 ✓ 1.
4 Sampling
5 ✗ -
6 [None Given]
7 ✓ 2.
8 Quantization
9 ✗ -
10 [None Given]
11 ✓ 3.
12 Binary Encoding
13 ✗ -
14 [None Given]
15 ✓ 4.
16 Digital-Digital Encoding
17 ✗ -
18 [None Given]
19 Response Feedback:
20 The sequence is given in reader A1, page 257-258 (old reader A1, p174).

100 Question 11

0 out of 1 points

1

1 Viterbi encoding _____ the number of transferred bits.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ doubles
5 Response Feedback:
6 Viterbi encoding doubles the number of transferred bit.

101 Question 12

0 out of 1 points

1

1 Arrange the following according to their size in bits. 1 is for the lowest amount of bits and 3 for the highest.
Answer

1 Correct Answer
2 Selected Answer
3 ✓ 1.
4 Command
5 ✗ -
6 [None Given]
7 ✓ 2.
8 Packet
9 ✗ -
10 [None Given]
11 ✓ 3.
12 Frame
13 ✗ -
14 [None Given]
15 Response Feedback:
16 The lowest amount of bits is the Command itself. The next level is the Packet and than the Frame. Read SSE, section 13.3 or consult the reader A1, page 252 (old reader A1, p165).

102 Question 13

0 out of 1 points

1

1 A wire pair has a bandwidth of 2 kHz. What is the limit (in bits/sec = bps) for transmission?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 4000
5 Answer range +/-
6 10 (3990 - 4010)
7 Response Feedback:
8 See example problem as treated in class.

103 Question 14

0 out of 1 points

1

1 A voice signal with a bandwidth W = 8 kHz is transmitted using a 12 bits Analog to Digital Converter (ADC). What is the S/N (in dB) taking only maximum quantization noise into account.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 72
5 Answer range +/-
6 0.1 (71.9 - 72.1)
7 Response Feedback:
8 See SMAD, page 545.

104 Question 15

0 out of 1 points

1

1 Calculate the required data rate for a voltage measurement on board a spacecraft which requires an accuracy of 0.1V and has to be performed over a range of 0-5V, with a measurement frequency of 10Hz. (One parity bit included)
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 132
5 Answer range +/-
6 12 (120 - 144)
7 Response Feedback:
8 You're not correct, see the lecture notes part A1, p.163 and 164 and SMAD p.543-545

Telecommunications

105 Question 1

0 out of 0.5 points

1

1 If the orbital altitude of a satellite is increased by a factor 2, the received power flux density on the Earth from a transmitter on board this satellite is reduced by a factor 2.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Power flux density is proportional to the area of a sphere with the transmitter at its centre ($4pR^2$). Increasing the radius of this sphere by a factor two means an increase in area of a factor 4.

106 Question 2

0 out of 1 points

1

1 20W is ..... dBW (fill in the blank).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 13dBW
5 Response Feedback:
6 You are not correct, see SMAD p.554

107 Question 3

0 out of 0.5 points

1

1 Antenna gain may be expressed in dBW
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 You are not correct. Antenna gain is a dimensionless number (i.e. a factor), therefore it is expressed in dB instead of dBW. Furthermore, antenna gain is expressed in dB compared to an isotropic antenna which has (by definition) 0dBi gain. Therefore, antenna gain is expressed in dBi. See section 13.3.2 (page 554) of SMAD.

108 Question 4

0 out of 0.5 points

1

1 Consider a parabolic reflector antenna, increasing the antenna's diameter will increase the antenna gain.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Increasing the diameter increases the effective area of the antenna. Therefore more power is intercepted and therefore the antenna has a higher gain. See equation 13-7 on page 553 of SMAD.

109 Question 5

0 out of 1 points

1

1 Consider the space-ground link of the Apollo command module orbiting the moon and the ground station in Houston.
2 Calculate for this link the free space loss in dB using the following parameters:
3 f = 2.2 GHz
S = 3.844 x 10^8 m

Note: enter the absolute value of your answer, so if your answer is -100dB for instance, enter "100".
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 211
5 Answer range +/-
6 1 (210 - 212)
7 Response Feedback:
8 You are not correct, consult SMAD p. 554-555 or the appropriate section from the Reader A1.

110 Question 6

0 out of 0.5 points

1

1 Compared to BPSK, a QPSK modulated signal can carry twice as much information in the same bandwidth.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct, consult the Reader A1 and/or SMAD p.558 and 559

111 Question 7

0 out of 0.5 points

1

1 For the same bit error rate (BER), BPSK modulation requires a lower E_b/N_o ratio than FSK modulation
2 Note: For a certain bit, the E_b/N_o ratio gives the amount of energy received per bit divided by the noise spectral density.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct, check figure 13-9 on SMAD p.561

112 Question 8

0 out of 0.5 points

1

1 A satellite in GEO operates two links to a ground station. One operates at 4GHz, and the other one at 10GHz. Does the 10GHz link exhibit a higher path loss than the one at 4GHz?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 You are not correct, check SMAD p.552-555
7 hint: a higher frequency corresponds to a smaller wavelength l

113 Question 9

0 out of 1 points

1

1 A transmitter is transmitting a telecommunications signal. Transmission power is 3kW. Given that the transmitter is perfect, so there is no line loss, calculate the flux density at a distance 6000 km away from the spaceraft. Give the answer in 'pico Watts per meter squared'.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 6.63
5 Answer range +/-
6 0.30 (6.33 - 6.93)
7 Response Feedback:
8 The correct formula to use is:
9

This formula is contained in the reader A1, p271.
Notice the resemblence of this relation to the relation 11.1 given in SSE for the solar radiation intensity.

114 Question 10

0 out of 1 points

1

1 If a telephone network is available for 99.99 days out of 100, what is the link availability?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.9999
5 Answer range +/-
6 0.0009 (0.9990 - 1.0008)
7 Response Feedback:
8 The formula to use can be found in page 543 of SMAD.

115 Question 11

0 out of 0.5 points

1

1 The equivalent noise power that is received increases with the bandwidth of the receiver.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Consider the noise power spectral density, see SMAD p.554

116 Question 12

0 out of 0.5 points

1

1 The effect of quantization noise can be reduced only by increasing the number of quantization steps.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Wrong, the correct answer is false. This information can be found on page 545 of SMAD.

117 Question 13

0 out of 1 points

1

1 An arbitrary ground station receives a telecommunications signal with a bit rate of 85 bps and 1 W of signal power. What is the energy per bit? (Give the answer in Watt-Seconds [Ws])
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.0118
5 Answer range +/-
6 0.0010 (0.0108 - 0.0128)
7 Response Feedback:
8 Power per bit = Power recieved / Bit rate
9
10 SMAD eq 13-9 page 544

118 Question 14

0 out of 1 points

1

1 What is the noise spectral density (No) when the system noise temperature (Ts) is 250 K. Give the answer in Watts-per-Hertz [W/Hz]
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 3.45 e -21
5 Response Feedback:
6 SMAD eq.(13-10) page 554

119 Question 15

0 out of 1 points

1

1 Give the noise figure F in dB, when the noise temperature of the receiver is 40 K and the reference temperature is 290 K.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.5612
5 Answer range +/-
6 0.0100 (0.5512 - 0.5712)
7 Response Feedback:
8 Using equation 13.24 on page 557 of SMAD.

120 Question 16

0 out of 0.5 points

1

1 It is possible to reach the Shannon limit in practise?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 The statement is False, more information can be seen on page 563 of SMAD.

121 Question 17

0 out of 0.5 points

1

1 We have three values 'a', 'b' and 'c'. When we turn them to decibels, we get 'A', 'B' and'C' respectively.
2 Indicate if the following statement is true or false:
a = b/c, 10 log (a) is equal to A = B - C

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 The answer is true, when you convert to decibels, you can add instead of multiplying and subtract instead of dividing.

122 Question 18

0 out of 1 points

1

1 Thermal noise... (tick all that are correct)
Answer

1 Selected Answers:
2 [None Given]
3 Correct Answers:
4 ☑ Increases at high temperatures
5 ☑ is constant over all radio frequencies
6
7 Response Feedback:
8 See the information contained in the reader A1, p.274-278.

123 Question 19

0 out of 1 points

1

1 Which of the following characteristics of electromagnetic waves are modulated in AM signals?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ☑ Amplitude
5 Response Feedback:
6 Consult for instance SSE, section 12.2 on modulation

124 Question 20

0 out of 1 points

1

1 A SC transmits 20 Mbits. But, the ground station recieves 19.9 Mbits correctly. What is the bit error rate?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ☑ 0.005
5 Answer range +/-
6 0.000 (0.005 - 0.005)
7 Response Feedback:
8 Consult for instance the reader A1, section on telecommunications and more specific the slides on bit error rate.

125 Question 21

0 out of 1 points

1

Assume symbols with a length of 8 bits. If a code word is sent using Reed-Solomon code of (90,50), what is the parity?
(Answer must be given in bits)
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ 320
Answer range +/-
0 (320 - 320)
Response Feedback:
You must subtract 50 from 90 to give 40. Then multiply 40 by 8 to give 320 bits.

The correct answer is 320 bits.

Consult for instance the Reader A1, page 289 (or old reader A2, page 23)

126 Question 22

0 out of 1 points

1

Which modulation and coding scheme makes the best use of spectrum?
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ QPSK
Response Feedback:
Consult for instance the reader A1, page 291-292 (old reader A2, page 24).

127 Question 23

0 out of 0.5 points

1

At equal frequencies, rain attenuation increases with increasing elevation angle.
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ False
Response Feedback:
Rain attenuation decreases with increasing elevation angle. See SMAD figure 13.11 page 565.

128 **Question 24**

0 out of 0.67 points

1

1 Which antenna is better suited for frequencies below 4GHz?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Helical or Helix Antenna
5 Response Feedback:
6 The correct anwer is the Helical antenna or Helix antenna.

Consult for instance SSE, section on antenna types, starting page 436.

129 **Question 25**

0 out of 1 points

1

1 Which of the following multiple access systems requires most bandwidth (consider identical number of data bits to be transferred)?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ CDMA
5 Response Feedback:
6 The correct answer is CDMA. See page 579 of SMAD

130 **Question 26**

0 out of 0.67 points

1

1 At data rates above 100Mbps, which communication system generally is the lightest?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Optical
5 Response Feedback:
6 The correct answer is optical. See more information on pages 583-584 of SMAD.

131 **Question 27**

0 out of 0.5 points

1

1 Which of the following amplifiers is the most power efficient?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Travelling tube wave amplifier (TWTA)
5 Response Feedback:
6 Correct answer is TWTA. See figure 13.15 on page of 575 of SMAD. The curve of TWTA is below that of Solid state for the input vs output graph. This means that TWTA requires less power than Solid State to transmit equal amounts.

132 Question 28

0 out of 1 points

1

1 What is the total received noise power N when system noise temperature (Ts) is 200 K and receiver noise bandwidth is 0.2 MHz?
2
3 Give the answer in femto (10^{-15}) Watts.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.552
5 Answer range +/-
6 0.010 (0.542 - 0.562)
7 Response Feedback:
8 Correct answer is 0.552 fW . See eq 13.12 on page 554 of SMAD.

Propulsion

133Question 1

0 out of 1.5 points

1

The propulsion system effects ....
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ vehicle mass
- ☑ vehicle reliability
- ☑ vehicle cost
- ☑ vehicle safety
- ☑ vehicle size
- ☑ mission delta v

Response Feedback:
Check your lecture notes Propulsion Part A2.

All of the above are effected by the propulsion system!

134Question 2

0 out of 0.5 points

1

For space propulsion we need to have mass expulsion.
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
☑ False
Response Feedback:
Fundamental Physics. Consider for instance solar/laser/light sailing.

135Question 3

0 out of 1 points

1

A satellite with an initial mass of 1000 kg undergoes a velocity increase of 1 km/s using an impulsive shot. The used rocket motor has a thrust of 4000 N and an effective exhaust velocity of 4 km/s. What is the propellant mass needed to realize this velocity change?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 221 kg
5 Response Feedback:
6 Using the rocket equation, we get:
7 1000 m/s = 4000 * natural log (1000/x), with x being the unknown empty mass. it follows for the empty mass a value of 778.8 (= 779 kg). This gives a propellant mass of 1000-779 = 221 kg.

136Question 4

0 out of 1 points

1

1 In general terms, the total impulse of a rocket motor is ...
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ The product of average motor thrust and its burn time.
5 Response Feedback:
6 Total impulse is the amount of thrust produced by a motor over its action time. For instance, a motor may produce 100 Newton of thrust for 4 seconds resulting in a total impulse of 400 Newton-seconds.

137Question 5

0 out of 1 points

1

1 For a thermal rocket engine true exhaust velocity is maximized in case we select a propellant with:
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ low molar mass and low specific heat ratio
5 Response Feedback:
6 See page 176 of Spacecraft Systems Engineering or page 689 of SMAD.

138Question 6

0 out of 1 points

1

1 A thermal rocket engine uses a chemical propellant that during combustion releases 42 MJ/kg. Specific heat of the propellant is 14000 J/(kg-K). What is the increase in temperature of the propellant gases due to combustion in case the molar mass of the combustion gases is equal to 2.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 3000 deg C
5 Response Feedback:
6 mass flow * 42 MJ/kg = mass flow * 14 kJ/(kg-K) * Delta T
7
8 This gives Delta T is 3000 K

139Question 7

0 out of 1.5 points

1

1 A 1 N resistojet with a specific impulse of 320 s uses nitrogen heated to 2500 K as propellant. Specific heat at constant pressure of nitrogen is 1.04 kJ/(kg-K). What is for this engine the power needed to heat the nitrogen propellant flow to the required temperature in case the initial temperature of the nitrogen gas is 300 K and thermal losses to the environment can be neglected?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 700 Watt
5 Response Feedback:
6 Check your lecture notes.

140Question 8

0 out of 1.5 points

1

1 An ion engine uses Xenon gas as propellant. What is the exhaust velocity that can be achieved for a potential difference between anode and cathode of 3000 Volt?Tip: See for comparison the problem 7.4.5 from the workbook.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 66.1 km/s
5 Response Feedback:
6 Check your units.
7
8 Taking the electric charge for the Xenon ion as 1.6 x 10^-19 Coulomb (assuming all ions are singly charged) and the molar mass as 131.3 kg/kmol, we find that the exhaust velocity of this engine is:
9
10 $v = SQRT(2 \times 1.6 \times 10^{-19}/(131.3 / 6.022 \times 10^{26}) \times 3000) = 66.1$ km/s.

141Question 9

0 out of 1.5 points

1

1 Put the following types of propulsion in order of increasing propellant consumption (identical thrust level)
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 ion propulsion
5 ❌ -
6 [None Given]
7 ✅ 2.
8 arcjet
9 ❌ -
10 [None Given]
11 ✅ 3.
12 resistojet
13 ❌ -
14 [None Given]
15 ✅ 4.
16 bipropellant
17 ❌ -
18 [None Given]
19 ✅ 5.
20 hybrid
21 ❌ -
22 [None Given]
23 ✅ 6.
24 solid
25 ❌ -
26 [None Given]
27 ✅ 7.
28 monopropellant
29 ❌ -
30 [None Given]
31 ✅ 8.
32 cold gas
33 ❌ -
34 [None Given]
35 Response Feedback:
36 See for instance, SMAD, page 688, or Table 17-4.

142Question 10

0 out of 0.5 points

1 1 How many kJ is 100 Wt-hr?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 360
5 Answer range +/-
6 1 (359 - 361)
7 Response Feedback:
8 The correct answer can be obtained by multiplying the number of Watt-hour times the number of seconds in 1 hour. This gives 100 * 36700 sec = 360,000 J or 360 kJ.

143Question 11

0 out of 1.5 points

1

1 A solar-thermal propulsion (STP) system is designed to provide a thrust of 0.05 N and a specific impulse of 350 sec. For the thruster of this system we have designed a cylindrical shaped thruster receiver/absorber chamber with a length (l) of 10 cm and a diameter (d) of 2 cm. This chamber has a uniform temperature of 2700 K to allow heating of the propellant to a sufficiently high temperature. You are asked to calculate for this chamber the limit value of the effective emittance of the radiation shield needed to limit the heat loss to less than 5% of the thruster input power. You may assume that thruster input power is 100 Watt and you may neglect any other losses occurring.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.00024
5 Answer range +/-
6 0.00002 (0.00022 - 0.00026)
7 Response Feedback:
8 The allowed loss is maximum 5 W_t. Using Stefan-boltzan equation, we find that this requires an effective emittance of the MLI of less than 0.00024.

144Question 12

0 out of 1.2 points

1

1 Which unit fits with the term specific power?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ W/kg
5 Response Feedback:
6 Specific power of some equipment is the power per unit of mass of the equipment.

145Question 13

0 out of 1 points

1

1 What is the correct unit for specific impulse?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ seconds
5 Response Feedback:
6 Basic stuff,
7
8 See your lecture notes

146Question 14

0 out of 2.5 points

1

1 In the Annex D of Reader A2 an ion propulsion system is designed to produce a delta v of 4.71 km/s. For an effective exhaust velocity of 20 km/s it is calculated that the vehicle is limited to a mass of 1759 kg excluding the propulsion system. Note that the tank safety factor should be 2.5 instead of the value of 2 indicated in the text. Now it turns out that the effective velocity of the thruster is 15 km/s. Calculate the new vehicle mass (in kg) excluding the propulsion system. You may assume that all other variables remain the same (Use a tank safety factor of 2.5).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1638
5 Answer range +/-
6 20 (1618 - 1658)
7 Response Feedback:
8 From the rocket equation it follows a mass ratio of 1.368. This gives an empty mass of 3653 kg or a propellant load of 1347 kg. Adding 1% for expulsion efficiency this gives 1361 kg. Dry vehicle mass is than 3639 kg. Propellant volume now becomes 2.52 m^3. Tank volume is set equal to propellant volume, leading to a tank diameter of 1.69 m. Using relation (17-20) from SMAD gives a tank wall thickness of 11.9 mm. The tank wall thickness combined with the mass density of the titanium material and tank surface leads to a tank shell mass of 470 kg and adding a correct factor of 1.5 gives a final tank mass of 705 kg. The mass of the miscelaneous items is estimated at 25% of tank mass or 176 kg. Mass of the power generation system is estimated based on a beam power of 10.5 kW and a total power required of 14 kW. This gives 560 kg. For the power conversion system we estimate a mass of 560 kg. This leaves a vehicle mass (excluding the propulsion system) of 1638 kg.

147Question 15

0 out of 1.5 points

1

1 in STP design a solar-thermal propulsion (STP) system is designed for a thrust of 0.05 N and a specific impulse of 350 sec. For the thruster of this system we have designed a cylindrical shaped thruster receiver/ absorber chamber with a length (l) of 10 cm and a diameter (d) of 2 cm. Assume that this chamber has a uniform temperature of 2700 K to allow heating of the propellant to a sufficiently high temperature. Calculate the heat loss (in kW_t, 1 digit behind the decimal sign) by radiation that occurs in vacuum in case the chamber is made of graphite with an emissivity factor of 0.90? You may assume that no energy is received from cold space or from elsewhere. Note: To answer this question, consider the lecture material on thermal control.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 18.7
5 Answer range +/-
6 0.2 (18.5 - 18.9)
7 Response Feedback:
8 We first calculate the outside suface area S of the chamber: S= 2 x PI()/ 4 *d^2 + PI()*d*l = 69 cm^2 Next we use the Stefan-Blotzman equation to calculate the radiated heat flux q: q = 5.67e-8*0.9*2700^4= 2.7 MW/m^2 Finally, we determine the total heat flow Q in kW_t: Q = q * S = 18.7 kW_t.

148Question 16

0 out of 0.5 points

1

1 A blow down feed system ensures a constant thrust during the operation of the thruster.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Read SMAD, pages 709 and 710.

149Question 17

0 out of 0.5 points

1

1 Under identical conditions (same tank volume, tank pressure, etc.) we find that a cylindrical tank is lighter than a spherical tank.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See SMAD, page 714, eqs. 17-19 and 17-20. Under equal loading, the wall thickness of the cylindrical part of a tank is twice that of a spherical section.

150Question 18

0 out of 1.2 points

1

1 Thrust and specific impulse of a thermal rocket motor ....
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ decrease with decreasing altitude
5 Response Feedback:
6 Study the thrust equation ($F = m\ v_e + (p_e - p_a)\ A_e$) relation as well as the definition of the specific impulse in more detail. Pay attention to how a change in altitude effects the atmospheric pressure. Also consider the effect of altitude on the other parameters that determine the thrust magnitude.

151Question 19

0 out of 1.2 points

1

1 The true exhaust velocity of a thermal rocket is independent of ....
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ atmospheric pressure
5 Response Feedback:
6 See SMAD, page 688 and 689 or SSE, page 176.

152Question 20

0 out of 1 points

1

1 For an ion engine, exhaust velocity increases with:
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Decreasing molar mass and increasing beam voltage
5 Response Feedback:
6 Read section in lecture notes on ion engines

Mission concept exploration

153Question 1

0 out of 5 points

1

1 Space mission concept exploration is an interdisciplinary approach.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See lecture notes, part B, page 9 and page 57.

154Question 2

0 out of 10 points

1

1 Match the following content with the appropriate uncompressed (digital) data rate:
Answer

1 Question
2 Correct Match
3 Selected Match
4 Text
5 ✓ B. 50-80 bps
6 [None Given]
7 Voice
8 ✓ D. 64 kbps
9 [None Given]
10 HDTV
11 ✓ C. 400-1500 Mbps
12 [None Given]
13 FM radio quality
14 ✓ A. 1024 kbps
15 [None Given]
16 Response Feedback:
17 See lecture notes part B page 21. Do you know that compression (for instance MPEG-2) can significantly lower the bit rate, see below for typical MPEG-2 Transmission Rates:

- Movies (VHS quality) 1.152 Mb/s
- News/Entertainment 3.456 Mb/s
- Live Sports Event 4.608 Mb/s
- 16:9 Wide Screen TV 5.760 Mb/s
- Studio Quality Broadcast TV 8.064 Mb/s
- High Definition Television 14.00 Mb/s
- Monaural sound 0.128 Mb/s
- Stereo sound (L + R) 0.512 Mb/s
- Digital Data 9.6 kb/s

155Question 3

0 out of 10 points

1

1 Fill in the blank: "For commercial space missions, investors typically require ... Return On Investment (ROI).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 15-20%
5 Response Feedback:
6 With increasing risk the ROI increases. Putting your money on the bank is not considered low risk and generally earns you 2-4%. Space is considered a risky business. About 10% of all space launches fail. Also spacecraft tend to fail in orbit. Hence 15-20% is the more likely number, see also lecture notes Part B page 26.

156Question 4

0 out of 10 points

1

1 A satellite costs 100 million Euro, which has been paid for by a group of wealthy investors. Operations cost of the satellite are 10 million Euro per year. Earnings each year are 100 Euro per user. How many users are needed (constant in time) to allow for paying back the investors in full after 10 years and to give them a profit of 10% ROI ? You may neglect any effect of interest over the money earned.

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 300.000 users
5 Response Feedback:
6 To pay back the spacecraft in 10 years, we should earn 10 MEuro/year. To this we should add the operations cost of 10 MEuro/year. 10% ROI requires us again to earn 10MEuro/year bringing the total to 30MEuro/year. This then requires 300000 users minimum.
Also consider that in case we put the 10MEuro/year for paying back the investors on the bank at an interest rate of 4%, this earns us 10MEuro x 1.04^9 + 10MEuro x 1.04^8 + etc. = 110MEuro (instead of 100MEuro). This than reduces the number of users we need to break even or increases our own earnings.
In case we pay back the investors every year 10 MEuro, we could again increase our earnings.

157Question 5

Needs Grading

1

1 Read the text on NASA oceanography from
2
3 http://nasascience.nasa.gov/earth-science/water-and-energy-cycle
4
5 According to this text, why is NASA studying the oceans?
6
7 Keep your answer limited to not more than 100 words.
Answer

Selected Answer:

Correct Answer:

✅ To develop an understanding of the total Earth system and the effects of natural and human-induced changes on the global environment.

Our oceans play a major role in influencing changes in the world's climate and weather. Collecting and analyzing remotely-sensed, long-term ocean data makes it possible to understand the ocean's role in more details.

Response Feedback:

[None Given]

158Question 6

0 out of 10 points

1

You are flying an observation camera on board of a LEO satellite. You find it hard to meet the requirement that the whole of earth should be viewed every day. Which of the following design parameters would you vary to find a solution for this problem:

1. Increase orbital altitude
2. Decrease orbital altitude
3. Increase field of view (FOV) of the instrument
4. Increase number of satellites
5. Increase number of pixels
6. Increase instrument solid angle

Answer

Selected Answer:

❌ [None Given]

Correct Answer:

✅ 1,3,4,6

Response Feedback:

Decreasing orbital altitude in general reduces the surface area that can be viewed.

Increasing the number of pixels in your camera does not always provide you with a wider view. This greatly depends on the angle of view.

159Question 7

0 out of 10 points

1

1 You are designing a space mission with as purpose to study climate changes and to perform weather predictions. Which of the following parameters can be used for weather prediction.
2 1. Water vapour content
3 2. Atmospheric pressure
4 3. Cloud coverage
5 4. Wind speed (magnitude only)
6 5. Wind direction
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1 to 5
5 Response Feedback:
6 See http://www.theweatherprediction.com/basic/

160Question 8

0 out of 10 points

1

1 Space mission concept exploration is about finding out amongst others:
- What the users want
- What the requirements are for the spacecraft subsystems
- Whether we can make a profit or not
- The risks involved
- Which of the user requirements is/are most influential on cost and development schedule
- The required elements in the system

2
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1,3,4,5,6
5 Response Feedback:
6 The requirements for the spacecraft subsystems are generally dealt with in a later phase of the design. First we have to establish the requirements for the system as a whole as well as the system elements. Later we can than define the requirements for the subsystems making up the elements.

161Question 9

0 out of 10 points

1

1 Match the following:
Answer

1 Question
2 Correct Match
3 Selected Match
4 Data Delivery
5 ☑ D. How mission and housekeeping data are generated or collected, distributed and used
6 [None Given]
7 Communications Architecture
8 ☑ A. How the various components of the system talk to each other
9 [None Given]
10 Tasking, Scheduling and Control
11 ☑ B. How the system decides what to do in the long term and short term
12 [None Given]
13 Mission Timeline
14 ☑ C. The overall schedule for planning, building, deployment, operations, replacement, and end-of-life
15 [None Given]
16 Response Feedback:
17 See SMAD page 21

162Question 10

0 out of 10 points

1

1 Which of the following requirement(s) clearly do violate one or more characteristics (except traceability and accessibility) of a good requirement?
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ The size of the user terminal shall be minimized.
- ☑ System safety shall be optimized.
- ☑ Maintainability and safety of the system shall be equal or better than 0.8.
- ☑ The reliability of the thermal control subsystem of the spacecraft shall be in the range +/- 10K.
- ☑ The availability of images from the observation payload over the mission life shall be 100%

Response Feedback:
Only requirement 3 does not violate any of the characteristics for a good requirement, see part B, page 17.
Requirement 1: The word minimized is not unambiguous. Furthermore, the requirement is not quantitative.
Requirement 2: The word optimized is not unambigous. What is optimum for one person is not optimum for the other. In addition, the requirement is not quantitative.
Requirement 4: This requirement is not unique.
Requirement 5: Reliability has nothing to do with accuracy. It is a probability and is expressed as a percentage or a fraction.
Requirement 6: An availability of 100% is just like a reliability of 100% impossible to achieve.

See for a comparable problem the AE2-S02 problems workbook, problem 7.3.

163Question 11

0 out of 5 points

1

User total cost depends on amongst others equipment cost, subscription fee and costs for installation.
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
☑ True
Response Feedback:
Study lecture notes, Part B, page 26. See for example: Cost of internet via satelite

164Question 12

0 out of 10 points

1

1 What's the (fractional) availability of a system which is out of order 10 hours a year?
2
3 Give the answer in 3 decimals (< 1)!
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.999
5 Answer range +/-
6 0.0005 (0.9985 - 0.9995)
7 Response Feedback:
8 1-(10hr / (365*24hr)) = 0.999

165Question 13

0 out of 10 points

1

1 You aim to provide colour photos of Earth each covering an area of 8km by 8km. You would like to provide a resolution of 0.5m. What is the minimum number of picture elements required?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 256 mega-pixel
5 Response Feedback:
6 The minimum number is determined by the size of the area viewed and the resolution required. It follows: 8000m/0.5m x 8000m/0.5m = 256 x 10^6 pixels.
7
8 Pixel is short for Picture element.

166Question 14

0 out of 10 points

1

1 Which of the following statements are true:
- Communications data can be gathered via mobile or fixed communications link.
- Extensive data processing is required before data delivery.
- Electromagnetic spectrum for communications purposes is allocated through the ITU/WRC.

2

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1,3
5 Response Feedback:
6 See lecture notes Part B, pages 27, 28 and 34.

167Question 15

0 out of 5 points

1

1 Does the space mission statement
"To explore outer space"
fulfil all requirements for a good mission statement?

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 This statement is considered inadequate as it lacks at least some indication of why and for whom we are doing it. See also lecture notes, part B, page 11.
Can you think of an improved statement?
How about "to explore outer space for unknown life forms for the benifit of the human race".

168Question 16

Needs Grading

1

1 You are discussing the design of a satellite system capable of digitally broadcasting 100 videos of HDTV quality over Europe simultaneously with the possibility of constraining some of the videos transmissions to certain areas only. What frequency band (C/Ku/Ka) would you select for the transmissions and what bandwidth (approximate value) is needed in case we use a signal compression ratio of 10.
Answer

Selected Answer:

Correct Answer:

✅ 1 video of HDTV quality requires 400-1500 Mbps (see lecture notes, part B, page 21). Times 100 this gives 40-150 Gbps. With compression this comes down to a bit rate of 4-15 Gbps (40-150 mbps). Using QPSK (this is the standard for satellites), the transmitted spectrum width is 2-7.5 GHz (20-75 MHz per video channel).

Frequency bands possible are Ku and Ka. The latter is upcomming. Actual bit rates depend on the HDTV standard used (DVB, ATSC, etc), but also on signal quality (depends on compression factor, error coding, etc.) see for instance http://www.ebu.ch/en/technical/trev/trev_256-dosch.pdf). This does not really affect the grading provided a source is given and no errors are made.

In case the students makes a point of the variations, he can earn himself double the points as for the standard answer.

Response Feedback:

[None Given]

169Question 17

0 out of 10 points

A typical spacecraft discription includes:

1. Mass
2. Reliability
3. User equipment cost
4. Up/downlink data rate
5. Mission life
6. Orbit

Answer

Selected Answer:

❌ [None Given]

Correct Answer:

✅ 1,2,4

Response Feedback:

The correct answer is D.

User equipment cost clearly is a characteristic of the user equipment and not the spacecraft.

Mission life is not necessarily identical to S/C life.

Orbit is usually not considered as a descriptive parameter for the spacecraft, but rather of the space mission.

Study lecture notes, page 45.

170Question 18

0 out of 5 points

1

1 Space mission concept describes how the mission will work- that is how it satisfies the end user's needs.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SMAD or lecture notes, part B, page 6, or "SSE Space mission exploration website"

171Question 19

0 out of 10 points

1

1 What does the acronym 'RAMS' stand for?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Reliability, Availability, Maintainability and Safety

172Question 20

0 out of 5 points

1

1 A development schedule is a time-tagged list showing the (duration of the) various phases in the development of a mission.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Study lecture notes, part B, pages 45 and 46.
7
8 Do you know that the planning, designing, building, launching and operating of a space mission are long-term operations. Usually, more than a decade is required to put a new scientific satellite into orbit. For commercial satellites, this period usually is less (typically about 3 years), as one tends to use more proven technology.

173Question 21

0 out of 10 points

1 

1 To analyse the effect of design changes and changes in requirements on mission performances different types of assessments/studies exist. Order the next few assessment/study types in order of increasing complexity/work (cost).
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Feasibility assessment
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Sizing estimate
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Point design
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Trade study
17 ❌ -
18 [None Given]
19 ✅ 5.
20 Performance assessment
21 ❌ -
22 [None Given]
23 ✅ 6.
24 Utility assessment
25 ❌ -
26 [None Given]
27 Response Feedback:
28 See lecture notes, part B, page 43. Read also lecture notes, part B, page 59 and 60, section "Evaluate design options" and SMAD, chap.3.

174Question 22

0 out of 10 points

1 

1 Put the following steps in the development of a space mission in the right order (sequence). First the step you would like to start with and than so on.
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Explore mission concept
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Perform design
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Produce hard & software
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Verify design
17 ❌ -
18 [None Given]
19 ✅ 5.
20 Operate system
21 ❌ -
22 [None Given]
23 Response Feedback:
24 See lecture notes, part B, page 8. For further reading, see lecture notes, part B, pages 55 to 56.

175Question 23

0 out of 10 points

1

1 Typical orbit characteristics include:
2 1. Primary pointing direction
3 2. Inclination
4 3. Number of spacecraft in orbit
5 4. Delta v budget for orbit transfer
6 5. Timeliness of data distribution

Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ 2,4
5 Response Feedback:
6 See SMAD, section on mission characterization, summary tables on orbit characteristics, etc.

176Question 24

0 out of 5 points

1

1 With availability and quality of the GPS signal we mean one and the same.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See lecture notes, part B, page 23 and 29 for a definition of quality and availability. Also consider that the quality of the signal may be OK, but that the receiver is out of order. Hence in that case, the positioning service is no longer available.

177Question 25

0 out of 10 points

1

1 In case you are in need of a high spatial resolution on ground, would you choose a GEO or Polar orbit?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Polar
5 Response Feedback:
6 GEO orbits have a low ground spatial resolution. The high orbit imposes a limit of about 1 km at best with current instrument technology. Polar orbits have a good ground resolution because of low orbit.

178Question 26

0 out of 10 points

1

1 An astronomer requires us to view the whole night sky (360 degrees around) every two days with each section of the sky being in view for at least 1 hour. What is the minimum required solid angle (in steradian) for the instrument FOV? (answer in 2 decimals)
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.26
5 Answer range +/-
6 0.01 (0.25 - 0.27)

Costing

179Question 1

0 out of 10 points

1

1 You are designing an IR telescope with an aperture diameter of 0.8m. Using SMAD, determine for this instrument the theoretical first unit (TFU) cost (in FY00 M$).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 126
5 Answer range +/-
6 0.5 (125.5 - 126.5)
7 Response Feedback:
8 You should use SMAD, Table 20-5, relation for IR sensor.
Result is 142,742 (0.8)^0.562 = 125.9 M$.
Do you know that a cost estimation tool is available on Blackboard that might be useful for checking your answers?

180Question 2

0 out of 10 points

1

1 Put the following types of cost analysis in order of increasing accuracy and effort:
2 a. Bottum up estimation
3 b. ROM
4 c. Parametric
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ b, c, a
5 Response Feedback:
6 Early in a project, you will probably use ROM cost estimation, whereas later when more design details are available you will progress towards parametric estimation and finally to Bottum Up Costing. Read also section 20.1.2 from SMAD.

181Question 3

0 out of 10 points

1

1 Arrange the following items to their importance for budgetting. Start with the most expensive item.
2 a. Payload
3 b. Propulsion subsystem
4 c. ACS subsystem
5 d. Structure subsystem
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ a, c, d, b
5 Response Feedback:
6 You are incorrect! The correct order is given by answer c, see the Pie chart on page 76 of Reader B (p. 191 old reader B) . However, you should keep in mind that the data in the pie chart are average data only and that data for an individual satellite may deviate from the data on slide. For this, it would be interesting to know about the standard deviation.

182Question 4

0 out of 10 points

1

1 Using the ROM cost estimation on page 81 of the lecture notes, part B, (P. 200 old reader) you are asked to come up with a total cost estimate for a mobile satellite communications system. The following data are to be considered:
2 - 20 S/C each with a mass of 1000 kg
3 - Ariane 5 as launcher
4 - 5 S/C launched at the same time using Ariane 5 (shared launch).
5 - Mission life 10yr
6 - Interest rate; 8%
7 - No pay back before mission is over
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ M$8000
5 Response Feedback:
6 Pitty. Below I will show you how I got the answer. The thing you must realize is that it is a ROM estimate with quite some inaccuracy. Exact numbers are in that case not really what is needed.
7 - 20 S/C each with a mass of 1000 kg at 100,000 $/kg gives total 2 billion$
8 - Ariane 5 as launcher: launch costs are 130 M$
9 - 5 S/C launched at the same time using Ariane 5 (shared launch), meaning 4 lauches in total. This amounts to M$520. Because of sharing, we estimate the total cost M$260.
10 - Mission life 10yr: This leads to an operations cost of 120 M$
11 - Ground segment is estimated at 17.5% of total mission cost. This than gives a total mission cost of (M$2000 + M$260 + M$120)/0.825 = M $2885 including M$505 for the ground segment.
12 - Adding 15% insurance and 10% project reserve, this amounts to a total cost of M$3650.
13 - Adding the interest rate of 8% over the mission life brings the final cost to M$3650 x 1.08^10 = M$7880.

183Question 5

0 out of 10 points

1

1 You want to launch a satellite into LEO. For this, you choose the PSLV. The price is given in FY2000 $, what is the price in FY2006 $? (Give the answer in M$)
2
3 Hint: Look up data on page 93 of Reader B.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 19.65
5 Answer range +/-
6 0.65 (19.00 - 20.30)
7 Response Feedback:
8 Wrong! The correct answer was 19.65 M$. First look up the cost on page 93 of Reader B (p.213 old reader) to be 17.5 M$. Table 20-1 on page 791 of SMAD says that inflation factor of year 2006 relative to 2000 is 1.123. The final answer is 17.5*1.123 = 19.65 M$. You should realize that the inflation factor for the year 2006 from SMAD is a prediceted value and in reality might be different. So an issue is how to get the latest inflation factors?

184Question 6

0 out of 10 points

1

1 A satellite mission costs 500 million dollars. The money will be paid back after a period of 3 years including an interest rate of 6% a year. What is the cost of financing?
2 (Give the answer in M$)
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 96
5 Answer range +/-
6 1 (95 - 97)
7 Response Feedback:
8 Wrong! The correct answer is 95.5 million dollars. The cost of financing can be estimated by subtracting the original sum from the final sum to be paid including interest. The final sum to be paid is 500 x 1.06^3 = M $595.5.

185Question 7

0 out of 10 points

1

1 The learning curve slope and the doubling factor are two different factors determining the time/cost reduction when doubling the numbers produced.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See again the lecture notes on cost engineering. They are essentially the same.

186Question 8

0 out of 10 points

1

1 Which of the following cost estimation methods is most appropriate for performing trade studies?
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ Parametric estimating
Response Feedback:
Wrong! Parametric cost models are the most appropriate for trade studies. You can read about the different cost estimation methods on page 199 of Reader B and on pages 787-788 of SMAD.

187Question 9

0 out of 10 points

1

You have estimated the following cost data (in M$):
RTD&E: 100 (10%)
S/C: 40 (10%)
Integration, Assembly & Test: 4 (20%)
Program Level: 2 (20%)
Ground Support Equipment 4 (10%)
Launch & Orbital Operations 80 (4%)

The numbers in brackets give the SE as a percentage of the cost for the item under consideration. What is the SE of the summed cost? (Give the SE as a percentage of total cost).
Answer

Selected Answer:
✗ [None Given]
Correct Answer:
✓ 4.9
Answer range +/-
0.2 (4.7 - 5.1)
Response Feedback:
You are incorrect. The absolute SE is respectively M$ 10, 4, 0.8, 0.4, 0.4, and 3.2. To estimate the SE of the sum, we must take the RSS of the individual SE. We find: SQRT (10^2 + 4^2 + 0.8^2 + 2 x 0.4^2 + 3.2^2) = M$11.3. The summed cost are M$230. The SE of the sum is 11.3/230 x 100% = 4.9%. See SMAD, section 20.4 and/or the example on page 814.

188Question 10

0 out of 10 points

1

Repetition of the same task leads to
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ less time or effort expended on that task
5 Response Feedback:
6 Wrong! Repetition of the same operation results in less time or effort expended on that operation. This is the underlying basis of the Learning effect. See page 85 of Reader B (pages 205-206 of old Reader B).

189Question 11

0 out of 10 points

1

1 You are evaluation two projects. Project A has a three year development with funding requirements (in M$) of 10 in year 1, 5 in year 2 and 1 in year 3. Project B has a three year development with funding requirements (in M$) of 1 in year 1, 5 in year 2 and 10 in year 3. Both projects perform the same. Which project would you select?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ project B
5 Response Feedback:
6 Study SMAD section 20.4.2.

190Question 12

0 out of 10 points

1

1 A small company in the Netherlands has developed a glovebox for use in space. TFU cost are 5 M$. This company aims to manufacture/build at least 100 of these gloveboxes. What is in that case the average cost price of a single unit. You may assume a learning curve slope of 90%.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 2.49
5 Answer range +/-
6 0.01 (2.48 - 2.50)
7 Response Feedback:
8 By doubling the number of items build we can reduce the average cost with a factor 0.9. Using SMAD, relation 20-5, we find: B = 0.847
L =$100^{0.847}$ = 49.7Are you aware that a doubling factor of 85% is common in aerospace engineering? In aerospace engineering we usually have a highly educated and motivated work force.
Please be informed that a slightly modified problem was part of the March 2008 exam for the course AE2-S02.

191Question 13

0 out of 10 points

1

1 You are designing the electrical power generation subsystem of a spacecraft. Given that this subsystem has a mass of 3000 kg, you are asked to calculate the total cost of this susbsystem in Fiscal Year 2000 M$ (FY00M$) for development and the first flight unit using the method outlined in SMAD. You may assume that the system essentially is identical to an existing design with only moderate modifications necessary. You may also neglect that the data may be out of range of the CERs used.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 144.4
5 Answer range +/-
6 30.0 (114.4 - 174.4)
7 Response Feedback:
8 To estimate the cost of the EPS, we use the cost tables 20-4 and 20-5 from SMAD.
9 Cost component
10 FY 2000 money
11
12 RDT&E cost of EPS
13 0.5 * 188.1 = 94.05 M$
14 Multiplication factor for Design Heritage = 0.5 (any value in the range 0.4-0.6 is OK)
15 TFU cost of EPS
16 50.38 M$
17
18 Total cost
19 144.4 M$
20
21
Please be informed that a slightly modified problem was part of the March 2008 exam for the course AE2-S02.

192Question 14

0 out of 10 points

1

1 In the lecture notes part B, page 93 (or 213 old reader), data are given for the launch cost of a range of launchers (from Ariane 4 to PSLV). Using this data, you are asked to determine a linear regression formula relating specific launch cost (launch cost (in k$) per kg payload) and payload mass (in tons)for launch to LEO.
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ y = 0.1378 x + 10.331
- ☑ y = 0.0325 x + 10.331
- ☑ y = 0.1945 x + 10.208
- ☑ y = 0.1447 x + 11.975

Response Feedback:
Sorry, this was not a true question. I just used the problem to demonstrate to you that there is a remarkable difference between the specific cost of Russian, Chinese and Western launchers. It may also help to illustrate that the Pegasus rocket is something of an outlier.
Note the answer 1 includes all points, 2 is the same except the Pegasus rocket, 3 is same as 2 but without the Russian launchers, and 4 is the same as 3 but now also without the Chinese launchers. When removing the PSLV, then the results will again change.
I still hope that you learned something from working on the problem and that you now understand better some of the problems you might face when figuring out cost data.

Availability maintainablity logistics

193Question 1

0 out of 0.5 points

1

1 Availability is the degree, percent or probability that a system is ready for use.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True

194Question 2

0 out of 1 points

1

1 You are designing a communications satellite. You have selected a transmitter power level that allows for succesful reception of the data even when heavy rains occur. Only 36 hours per year (1.5 days) the rainfall is thus heavy that reception of a good signal cannot be quaranteed. What is for this link the link availability. You may neglect any other failures occurring.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 99.589%
5 Response Feedback:
6 There are 8760 hours per year. Since we have an outage of 36 hours per year, this results in an availability of 36/8760 = 99.589%

195Question 3

0 out of 1 points

1

1 A device has been designed with an MTBF of 3 months. This means that .... of the devices will experience failure within 3 months.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 63.2 %
5 Response Feedback:
6 Reliability = e^(-1/3 * 3) = e^(-1) = 36.8%. Failure probability = 1 - R = 1 - 0.368 = 0.632 or 63.2%.

196Question 4

0 out of 0.5 points

1 Availability can be improved by incorporating redundancy.
Answer

Selected Answer:
❌ [None Given]
Correct Answer:
✅ True

197Question 5

0 out of 1.5 points

Maintainability is influenced by:
Answer

Selected Answers:
[None Given]
Correct Answers:
✅ Mean Time To Repair (MTTR)
✅ Mean Down Time (MDT)
✅ Time for diagnosis, tear down, removal/replacement, delays for logistic movements.
✅ Modular build-up

Response Feedback:
Maintainability deals with the duration of maintenance outages or how long it takes to achieve the maintenance actions.

198Question 6

0 out of 0.5 points

Availability increases with increasing reliability.
Answer

Selected Answer:
❌ [None Given]
Correct Answer:
✅ True

RAMS

199Question 1

0 out of 0.5 points

1

1 A reliability of 0.998 means that on average 2 items out of 1000 will fail.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Consider the probability of throwing "6" with a die (dobbelsteen).

200Question 2

0 out of 0.5 points

1

1 Failure probability summed up with reliability should equal 1 or 100%.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See equation 19.2 from SMAD.

201Question 3

0 out of 1 points

1

1 You are designing a S/C power subsystem with an operational life of 4 years and an MTTF better than 8 years. What is for this power subsystem the maximum allowable failure rate?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.125 failures per year
5 Response Feedback:
6 it is simply the reciproke value of the MTTF: 1/8 = 0.125 failures per year.

202Question 4

0 out of 1 points

1

1 You have developed an item with a failure rate of 0.2 on every 10.000 cycles. Determine for this item the probability of failure in case the item has a design life of 15 years with per year 1000 cycles.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.26
5 Response Feedback:
6 Did you consider that F = 1 - e^(-0.2*15000/10000)???

203Question 5

0 out of 0.5 points

1

1 Reliability can be improved by incorporating maintenance
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False

204Question 6

0 out of 1 points

1

1 To increase reliability, you put two identical components parallel that are both active. For the system to work well, at least one component should remain active. The reliability of a single component is 0.95. What is the reliability of the two components in parallel.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.9975
5 Response Feedback:
6 Study SMAD, pp. 765-766.

205Question 7

0 out of 0.5 points

1

1 A numerical value for risk is obtained by taking the product of the probability of succes and the consequence of failure
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Replace probability of succes by probability of failure.

206Question 8

0 out of 0.5 points

1

1 Development risk is probability that the operation of an item goes wrong times the additional cost that results when it goes wrong.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 You are mixing up development and operational risks.

207Question 9

0 out of 1 points

1

1 You are developing a platform for a space-based communications satellite. You aim to earn 100 million dollar per year. Which of the 4 S/C subsystems given below do you consider to be the highest risk item for the total system considering the information contained in the lecture notes, part B, section on risk determination.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Attitude control subsystem (ACS)
5 Response Feedback:
6 Consider the information in the lecture notes, part B, page 103.

208Question 10

0 out of 3 points

1

1 You are designing a service module for a lunar transfer vehicle. For this module, the vehicle systems engineer has required a reliability of 0.80 to survive a period of 15 weeks. To verify this reliability, you build and test 100 of these modules without repairs and determine the time to failure for each of these modules. The next table gives the results.

2	Weeks to failure
3	Number of items failed in period
4	0-10
5	20
6	10-15
7	10
8	15-20
9	15
10	20-25
11	14
12	25-30
13	14
14	30-35
15	7
16	

Determine for this module the Mean Time To Failure (in weeks).

Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 26.5
5 Answer range +/-
6 0.25 (26.25 - 26.75)
7 Response Feedback:
8 First we determine for each period some average time as well as the time that the number of failed items have operated. For instance for the first period the average time to failure is 5 weeks and the total operation time is 20 (the number of modules) * 5 (the weeks they have been operating) = 100. This we do for all periods. We should find a total operational time of 1415 weeks. Next we determine the total time that the 100 items have been operational. This is the earlier mentioned 1415 weeks in the table + 20 *35 wks (20 items are still active), which equals 2115 weeks. Mean time to failure is than 2115 weeks/80 is 26.43 weeks.Please be informed that this is one the the exam questions of the January 2008 exam AE2-S02.

209Question 11

0 out of 0.5 points

1

1 The level of development risk one is likely to accept is related to the development cost reserve.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 More risk, usually means that there is more money involved

210Question 12

0 out of 0.5 points

1

1 Failure rates are derived from test data only.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 No, failure rates of an item or device are also based on failures reported during the operational life of this item or device.

211Question 13

0 out of 0.5 points

1

1 In case a certain device has a constant failure rate over its life time, we may approximate its reliability using an exponential distribution.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See SMAD, page 765 or Fortescue and Stark, section 17.3.2.

212Question 14

0 out of 0.5 points

1

1 A requirement regarding reliability is equivalent to a requirement regarding failure rate?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 No. Reliability depends on both failure rate and life. the latter may be expressed in time or number of cycles.

213Question 15

0 out of 0.5 points

1

1 Failure rate generally increases with increasing age (you may neglect early life failures).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 Have you taken into account "early-life" failure? Consider also the "bath-tub' curve.

214Question 16

0 out of 0.5 points

1

1 To improve reliability, we should aim for series structures.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See SMAD, page 766

215Question 17

0 out of 1 points

1

1 The European Ariane 5 space launcher consists of 2 core stages (a lower and an upper stage) and 2 booster stages parallel to the lower stage. The booster stages act in conjunction with the lower stage. In case the reliability is 0.975 for the lower core stage, 0.985 for the upper core stage and 0.990 for each booster stage. Determine (accurate upto 3 digits behind the decimal point) the probability of a succesfull launch (all stages succesfull).
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.941

216Question 18

0 out of 1 points

1

1 You are generating a reliability budget for a commercial GEO communications satellite bus. In "Commercial Communications Satellite Bus Reliability Analysis" a figure is given showing the number of insurance claims by anomaly type. Assuming that this figure is representative for the business and that the failure percentages can be considered as based on random failures only and that failure rate is constant in time, you are asked to compute the reliability (as a fraction; accurate up to three digits behind the decimal point) of the battery system in case you are required to design the bus for a reliability of 0.9 over a 10 year life.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 0.988
5 Answer range +/-
6 0.0005 (0.9875 - 0.9885)
7 Response Feedback:
8 For the given bus life of 10 years, it follows that to achieve a bus reliability of 0.9, we must design for a total failure rate better than 0.010536 failure per year. Of these failures 11% (see data on web page) are due to the battery system or 0.0011589 failure per year. Reliability for the battery system over the life of the system than should be better than 0.988.
Note that by repeating the above calculations also for the other bus elements, you might be able to come up with a more or less realistic reliability budget. However, please give some thought to whether the assumption of random errors only and a constant failure rate are realistic (see also the data provided on the web page).

217Question 19

0 out of 1 points

1

1 How long should one test a single item to demonstrate a reliability of 0.98 over an operational life of 1 year with a confidence level of 90% allowing zero failures.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ ~114 year
5 Response Feedback:
6 MTTF ~ 49.5 years. Using the table from the lecture notes part B, page 125, we find a test time of 2.3 times the MTTF in case of a 90% confidence level and allowing zero failures. Read also SMAD section 19.2.4 and Fortescue and Stark section 17.3.4.

218Question 20

0 out of 1 points

1

1 You have designed a rocket motor with an operational life of 500 seconds and a reliability of 0.992. To demonstrate this reliability to the customer how many motors should be tested over 500 seconds to demonstrate this reliability level with a confidence level of 95% in case you allow 1 failure.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ ~591 engines
5 Response Feedback:
6 MTTF = ~125 times 500 sec. To have 95% confidence with 1 failure allowed, we should test 4.74 times the MTTF. This is ~591 engines each with a duration of 500 sec. In case it is possible to operate an engine over longer time than 500 sec, it is possible to reduce the number of engines to be used, thereby reducing cost (a lower number of engines have to be produced for testing). For example when using 5 engines (like in most large rocket motor programs), we should operate each engine for ~59.000 seconds or over 16.4 hours.

219Question 21

0 out of 0.5 points

1

1 An item with a technology readiness level (TRL) of 5 offers higher higher development risk than the same item at a TRL of 4.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 SEE TRLs in SMAD, page 804.

220Question 22

0 out of 0.5 points

1

1 Risk is the potential for realization of unwanted, adverse consequences to human life, health, property or the environment.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See lecture notes, part B, page 97.

Launch vehicle selection

221Question 1

0 out of 10 points

1

1 Launch system injection accuracy is a function of the vehicle/upper stage combination used.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 This is true, See lecture notes part B page 64.

222Question 2

0 out of 10 points

1

1 During launch, shock can rage upto 4000g
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 That's true! See lecture notes part B page 65

223Question 3

0 out of 10 points

1

1 What determines availability?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓
5 Response Feedback:
6 See lecture notes part B page 66

224Question 4

0 out of 10 points

1

1 Determine the availability of a system with: Stand down time = 1.0 Surge = 1.4 L = 8 Reliability = 1.0
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 1
5 Answer range +/-
6 0.1 (0.9 - 1.1)
7 Response Feedback:
8 The correct answer is 1 because the Reliability is 1.0 ! (given) See figure on page 67 of lecture notes Part B

225Question 5

0 out of 10 points

1

1 A number of upper stages are available to provide additional velocity beyond low-Earth orbit requirements. If you would need a Specific Impulse of at least 365 s, and you don't want to use a US military Orbital Transfer Vehicle, which of the following would you choose?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ H-10
5 Response Feedback:
6 Use table 18-5 on page 730 of SMAD See the "Specific Impulse" and "Sponsor" row in the table. The H-10 (ESA) has a Specific Impulse of 444.2 s and isn't a USAF vehicle.

226Question 6

0 out of 10 points

1

1 If your system requires a low lateral launch acceleration (Dynamic), which of the following vehicles would be preferable?
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ Atlas-II
5 Response Feedback:
6 See table 18-8 on page 740 of SMAD

227Question 7

0 out of 10 points

1

1 Injected weight is the Mission capable spacecraft weight
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 False! This is called the wet weight. The injected weight is the total weight achieving orbit. See page 725 SMAD

228Question 8

0 out of 10 points

1

1 When selecting a launcher, cost per kg is the only parameter on which selection is based.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Wrong! The statement is false. There are also other factors such as the reliability that must be considered before a decision is made.

MAIT

229Question 1

0 out of 1 points

1

An MAIT plan includes:
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ Test schedule
- ☑ Qualification approach
- ☑ Plan for assembly of the spacecraft
- ☑ Test conditions

230Question 2

0 out of 1 points

1

Spacecraft configuration control is about ....
Answer

Selected Answers:
[None Given]
Correct Answers:
- ☑ Defining, synchronizing and controlling all documents describing how the spacecraft looks like.

Response Feedback:
See Fortescue and Stark, section 17.7 or SMAD, section 12.1.

231Question 3

0 out of 1 points

1

Acceptance testing is to verify that ...
Answer

Selected Answer:
- ✗ [None Given]

Correct Answer:
- ☑ The hardware and software will fuction properly under the prescribed conditions for a stated period of time.

232Question 4

0 out of 0.5 points

1

1 Spacecraft assembly is usually conducted in a cleanroom class 100.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Read SMAD, page 521-523.

233Question 5

0 out of 1 points

1

1 Which of the following statements about the proto-flight approach are correct.
Answer

1 Selected Answers:
2 [None Given]
3 Correct Answers:
4 ✓ The proto-flight approach requires the life of the S/C to be a factor 1.5 longer than for the prototype approach.
5 ✓ The proto-flight approach is an approach towards qualifying a spacecraft.
6
7 Response Feedback:
8 Check Fortescue and Stark, page 552-553. See for further information also SMAD, page 798.

234Question 6

0 out of 0.5 points

1

1 RFA qualification described in Fortescue and Stark is for CAMS and COTS items and is to enable the use of such items for space application. In this respect it is just the same as qualifying by similarity.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 See Fortescue and Stark, section 17.1.2 and SMAD, page 525.

235Question 7

0 out of 0.5 points

1

1 A test table defines which tests are to be performed on what model.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ True
5 Response Feedback:
6 See syllabus, part B, page 275.

236Question 8

0 out of 0.5 points

1

1 A qualification test sequence is usually performed at random order.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Read SMAD, page 529.

237Question 9

0 out of 1 points

1

1 MAIT typically makes up ....% of the total development cost.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ 80-90
5 Response Feedback:
6 See syllabus part B, Vehicle Engineering, page 261, comments to slide 2.

238Question 10

0 out of 1 points

1

1 Order the following steps in time:
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Prepare engineering data
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Manufacture components
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Qualify components
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Integrate and test
17 ❌ -
18 [None Given]
19 Response Feedback:
20 See SMAD, page 520.

239Question 11

0 out of 1 points

1

1 Inputs for an MAIT plan include:
Answer

1 Selected Answers:
2 [None Given]
3 Correct Answers:
4 ✅ Number of spacecraft to be produced
5 ✅ Date of first delivery
6 ✅ Production cost
7 ✅ Production start date
8

240Question 12

0 out of 0.5 points

1

1 Quality assurance is the systematic control of the manufacturing process through inspection, test, analysis and review.
Answer

1 Selected Answer:
2 ❌ [None Given]
3 Correct Answer:
4 ✅ True

241Question 13

0 out of 1 points

1

1 Indicate the order in which the various items of a space system should be tested.
Answer

1 Correct Answer
2 Selected Answer
3 ✅ 1.
4 Parts
5 ❌ -
6 [None Given]
7 ✅ 2.
8 Components
9 ❌ -
10 [None Given]
11 ✅ 3.
12 Assemblies
13 ❌ -
14 [None Given]
15 ✅ 4.
16 Spacecraft subsystems
17 ❌ -
18 [None Given]
19 ✅ 5.
20 Spacecraft
21 ❌ -
22 [None Given]
23 ✅ 6.
24 Space system
25 ❌ -
26 [None Given]

242Question 14

0 out of 0.5 points

1

1 In what order a spacecraft is integrated is of no consequences to the design of the spacecraft.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 One usually starts with the structure as it provides for mounting of all the other equipment. Once the S/C body is complete, solar panels and other appendages (antenae, etc.) are attached. At the launch site, pyrotechnic items and solid rocket motors are integrated and/or the propellant tanks are filled, see Syllabus, part B,

243Question 15

0 out of 0.5 points

1 

1 Spacecraft assembly is usually conducted in a cleanroom class 100.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Read SMAD, page 521-523.

244Question 16

0 out of 0.5 points

1 

1 In a prototype approach the qualification test programme is applied, but only for half the full test durations.
Answer

1 Selected Answer:
2 ✗ [None Given]
3 Correct Answer:
4 ✓ False
5 Response Feedback:
6 Check Fortescue and Stark, page 552-553.