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STUDY GUIDE

**SAFETY OFFICERS EXAMINATION
AND
LEVEL II FLIGHT CERTIFICATION EXAMINATION**

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1. INTRODUCTION

1.1. UNITED KINGDOM ROCKETRY ASSOCIATION DOCUMENT

1.1.1. This document will not be published annually. Alterations or amendments to its contents will, however, be issued when necessary.

1.2. CORRESPONDENCE WITH THE ASSOCIATION

1.2.1. If you should need to correspond with the Association, with reference to this document, please send all correspondence via the main UKRA mailing address.

2. PURPOSE OF THIS DOCUMENT

2.1. The purpose of this document is to prepare the member to take the Safety Officer/Level II Certification examination.

2.2. The examination questions for the above Safety Officer/Level II Certification examination will be taken from this study guide.

2.3. Correct answers are indicated by an asterisk.

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3. QUESTIONS

QUESTION 1: What does 'CG' stand for in rocket terminology?

- A: Calculated gravity
- B: Centre of gravity *
- C: Concentric geometry

QUESTION 2: What does 'CP' stand for in rocket terminology?

- A: Centre of pressure *
- B: Circular parachute
- C: Calculated pressure

QUESTION 3: What relationship must the 'CG' of a rocket have to the 'CP' of a rocket for it to fly safely?

- A: The 'CG' must be greater than the 'CP'
- B: The 'CG' must be at least one body tube diameter forward of the 'CP' *
- C: The 'CG' must be at least one body tube diameter aft of the 'CP'

QUESTION 4: Which of the following suggestions would help most when making a marginally stable rocket safer to fly?

- A: Add weight to the nose *
- B: Make the fins smaller
- C: Use a less powerful motor

QUESTION 5: If the wind at your launch site is blowing toward trees at an average speed of 22mph should you. . . .

- A: Angle your rocket 10 degrees into the wind to minimise recovery drift
- B: Reduce the size of the parachute to increase descent rate
- C: Not fly your rocket at all *

QUESTION 6: You have a rocket, which is predicted to go to 2000ft on a 3 grain I236 reload but a strong breeze is blowing. For safety, what would be the best action to take. . . .

- A: Use a slower burning I170 reload to reduce the rockets peak altitude
- B: Use a smaller parachute to stop the rocket drifting out of the site
- C: Use a faster burning I345 reload to increase the rocket's take off velocity *

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QUESTION 7: If you recess the nozzle end of a rocket motor more than one body tube diameter into the base of a rocket what will happen?

- A: The 'Krushnick Effect' will cause the motor's power to be lost *
- B: The rocket will fly erratically due to the change in its 'CG'
- C: The 'Bernoulli principle' dictates the rocket may not lift off the launch pad.

QUESTION 8: You are making an ejection charge to be fired from an altimeter in a 4inch diameter rocket. The charge should be about:

- A: 1g in weight *
- B: 6g in weight
- C: 28g in weight

QUESTION 9: A rocket is predicted to reach 3400ft in altitude. Its potential maximum ballistic range is around. . .

- A: 2200ft
- B: 3400ft
- C: 7000ft *

QUESTION 10: A rocket is 6 inches in diameter, eight feet long and weighs around 6kg (approx. 13lbs) without a motor. A good motor for its first flight would be. . . .

- A: A 540Ns I470
- B: A 1261Ns J449 *
- C: A 3147Ns L935

QUESTION 11: A rocket motor of 1200Ns total impulse and burning for 6 seconds would be classed as a.

- A: J1200
- B: K200
- C: J200 *

QUESTION 12: Which of the following motors has the longest burn time?

- A: A 1280Ns J300 *
- B: A 700Ns J 200
- C: A 1000Ns J420

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- QUESTION 13:** Which of the following motors has the highest average thrust?
- A: A 1200Ns J400 *
 - B: A 1280Ns J280
 - C: A 2560Ns K250
- QUESTION 14:** What is the total impulse of a motor that gives 400N average thrust for four seconds?
- A: 400Ns
 - B: 400 Newtons
 - C: 1600Ns *
- QUESTION 15:** A rocket weighing 1kg (approx. 2lb) without motor and flying on a motor giving 800N of thrust will. . . .
- A: Probably crash because it is underpowered
 - B: fly well but not go very high
 - C: probably reach supersonic speed *
- QUESTION 16:** A rocket motor is classed as 'high power' if its propellant mass is greater than:
- A: 125g
 - B: 62.5g *
 - C: 100g
- QUESTION 17:** When does a UKRA Safety Officer have authority to cancel a launch?
- A: When consulted by the flyer
 - B: When the Launch Control Officer is unavailable to check a flight
 - C: At all times *
- QUESTION 18:** What is the minimum safe distance for spectators for a single 'I' powered launch?
- A: 45m (148ft) *
 - B: 15m (49ft)
 - C: 60m (197ft)

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QUESTION 19: A large rocket has a 54mm central composite reload & twenty D12 black powder motors surrounding it, all electrically ignited by individual igniters. What is the probable launch scenario?

- A: The central motor will light first then the 'D's will air light. The flight will be successful.
- B: The 'D's will light first lifting the rocket off the pad at a very low speed resulting in a probable crash when the central motor lights moments later.
*
- C: All motors will fire at about the same time.

QUESTION 20: A 4inch diameter rocket weighing 3kg (approx. 7lbs) and flying on a full 640Ns 'I' motor will reach about. . . .

- A: 1400ft
- B: 2500ft *
- C: 3900ft

QUESTION 21: A 6 inch diameter rocket weighing 7kg (approx. 15lbs) and flying on a full 2560Ns 'K' motor will reach around. . . .

- A: 1300ft
- B: 2200ft
- C: 4000ft *

QUESTION 22: A 2.6 inch diameter rocket weighing 1.5kg (approx. 3lbs) and flying on a 240Ns 'H' motor will reach around. . . .

- A: 900ft
- B: 2000ft *
- C: 3400ft

QUESTION 23: Which of Newton's laws of motion best describes the operation of a rocket motor?

- A: 1st law: A body will stay still or in constant motion in a straight line unless acted upon by a force.
- B: 2nd law: The rate of change of momentum in a body is proportional to the force acting upon the body.
- C: 3rd law: For every action, there is an equal and opposite reaction. *

QUESTION 24: What are the three forces acting on a rocket during flight?

- A: Thrust, body diameter and surface finish.
- B: Nose shape, thrust and aerodynamic drag.
- C: Gravity, thrust and aerodynamic drag. *

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QUESTION 25: What are the three factors that have the greatest effect on a rocket's peak altitude?

- A: Lift off weight, propellant weight and motor thrust.
- B: Fin size, propellant weight and motor thrust.
- C: Motor thrust, lift off weight and aerodynamic drag. *

QUESTION 26: To fly a rocket with a single motor of 2000Ns total impulse you must be UKRA certified to:

- A: Level 1
- B: Level 2 *
- C: Level 3

QUESTION 27: To fly a rocket powered by a cluster consisting of one 'H' class motor and thirty 'D' class motors totalling 840Ns you must be UKRA certified to:

- A: Level 1 *
- B: Level 2
- C: Level 3

QUESTION 28: All launch pads / towers must be:

- A: Rigid enough so as not to deflect or break under 30mph winds.
- B: Able to support the weight of the largest rocket that could be fitted to it.
- C: Rigid enough so as not to deflect under strongest launchable winds. *

QUESTION 29: A payload cannot be flown if it is:

- A: Likely to cause unnecessary radio interference.
- B: Inflammable in nature. *
- C: Over 2 times the weight of the empty rocket in which it is to be flown.

QUESTION 30: To achieve Level 1 certification you must:

- A: Successfully launch a rocket powered by motor/s of 160.01 to 640.01Ns total impulse.
- B: Successfully launch and retrieve a rocket powered by an 'H' or 'I' motor. *
- C: Successfully launch a rocket powered by an 'H' or 'I' class motor.

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- QUESTION 31:** A rocket containing seven motors ignited with fuses is:
- A: Automatically classed as experimental.
 - B: Not allowed to fly at a UKRA event.
 - C: Classed as a complex rocket and should be launched from a greater distance than an equal power rocket employing a single motor. *
- QUESTION 32:** A two stage rocket employing an 'I' class booster and 'H' class sustainer is:
- A: Classed as a 'complex' rocket and should be launched from a greater distance than an equal power rocket employing a single motor. *
 - B: To be treated in the same way as a single stage 'J' powered rocket.
 - C: Classed as a Level 2 rocket because its total impulse is over 640.01Ns.
- QUESTION 33:** A two stage rocket employing electronic ignition of the second stage crashes during first stage burn. The first thing the safety officer must do is:
- A: Check if the rocket is damaged.
 - B: Inform the Launch Control Officer of the situation then take a fire extinguisher to the rocket in case of a grass fire at the impact point.
 - C: Stop spectators approaching the live upper stage and make sure everyone is ready in case of a land shark. *
- QUESTION 34:** Which of the following (multiple answers) need to be checked on a high-powered rocket before allowing it to fly:
- A: Recovery system attachments. *
 - B: Fin attachment. *
 - C: Body tube strength. *
 - D: The nose cone has extra mass in it.
 - E: Inclusion of a static vent. *
 - F: All electronics are powered only by Duracell batteries.
 - G: Engine mount strength. *
 - H: The parachute has the correct sized spill hole.
- QUESTION 35:** A flyer wishing to launch an 8kg (approx. 18lbs) rocket on a 'L' class motor must have:
- A: A suitable NOTAM clearance, a Police licence to acquire or acquire and keep explosives and permission from the LCO.
 - B: Suitable NOTAM clearance, A Police licence to acquire or acquire and keep explosives, Level 2 certification and CAA clearance.
 - C: An HSE 'RCA' document, Level 2 certification and permission from the relevant launch official.
 - D: A police license to acquire or acquire and keep explosives, Level 2 certification and permission from the relevant launch official. *

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QUESTION 36: If anyone on the range shouts 'heads up' the safety officer must:

- A: Run for the nearest cover.
- B: Get the spectators to the nearest cover.
- C: Stand still and look up. *

QUESTION 37: If a NOTAM has been issued to 2500ft and a rocket is predicted to reach 2550ft in altitude the Safety Officer should:

- A: Refuse permission to fly. *
- B: Check over the altitude predictions to determine their accuracy.
- C: Consult with the LCO and make a visual check for aircraft before flight.

QUESTION 38: Night launching of high power rockets is only permitted:

- A: When illuminated recovery devices are employed.
- B: When illuminated recovery devices are employed, on November 5th or when special permission has been given by the Technical and Safety committee of UKRA for a non-illuminated night flight. *
- C: On November 5th, away from coasts and when illuminated recovery devices are employed.

QUESTION 39: All high power rockets should be designed to be recovered:

- A: By parachute.
- B: Within the boundary of the launch area.
- C: Substantially intact so as they can be launched again. *

QUESTION 40: A certification flight is considered successful when:

- A: The rocket is brought back to the certifying officer intact.
- B: The rocket is seen to successfully deploys its recovery system without major fault. *
- C: The rocket launches successfully.

PLEASE TURN TO YOUR DIAGRAM SHEET ON THE LAST PAGE OF THIS GUIDE.

QUESTION 41: What does the circular symbol on rockets 'A' and 'B' mean?

- A: Centre of gravity. *
- B: Centre of Pressure.
- C: Rotational symmetry point in diagram.

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- QUESTION 42:** What is wrong with the aft fins on rocket 'A' if it were intended for high speed flight?
- A: They are not big enough.
 - B: They are not of a delta design.
 - C: Their span is too great in comparison with their root edge. *
- QUESTION 43:** What effect may the forward fins have on the flight characteristics of rocket 'A'?
- A: They will add to its stability by increasing the overall fin area.
 - B: They will decrease its stability because they move its C/P forward. *
 - C: They will have little effect because of the rocket's length.
- QUESTION 44:** From the information supplied by the diagram would you expect rocket 'A' to be stable in low-speed flight?
- A: No it will probably be unstable. *
 - B: Yes it will probably be stable.
 - C: There is not sufficient information supplied.
- QUESTION 45:** Between rocket 'A' and 'B' which would be more likely to survive supersonic flight?
- A: Rocket 'A'.
 - B: Rocket 'B'. *
 - C: There is insufficient information supplied.
- QUESTION 46:** Between rocket 'A' and 'B' which is more stable?
- A: Rocket 'A'.
 - B: Rocket 'B'. *
 - C: There is insufficient information supplied.
- QUESTION 47:** Rocket 'B' has a solid hard-wood nose cone. For safety what would you recommend to the flyer?
- A: To use a light balsa or plastic nose instead.
 - B: To angle the rocket down range and launch in light breeze only. *
 - C: Not to fly at all because the rocket is too dangerous.
- QUESTION 48:** If rocket 'A' is 4" in diameter and weighs 3kg (approx. 7lbs) and rocket 'B' is 5" diameter and weighs 2.5kg (approx. 6lbs) which would reach the higher altitude if both were launched on identical motors?
- A: Rocket 'A'. *
 - B: Rocket 'B'.
 - C: There is insufficient information supplied.

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QUESTION 49: Between rocket 'A' and 'B' which has a more suitable nose shape for flight at 800mph?

- A: Rocket 'A' *
- B: Rocket 'B'
- C: Both are unsuitable for such high speed flight.

QUESTION 50: If rocket 'B' was to be used for a level 2 certification flight and there was a stiff breeze blowing what motor would you recommend be used?

- A: A 'J95' to keep airspeed low.
- B: An 'I435' to keep airspeed high.
- C: A 'J350' to keep airspeed moderate. *

QUESTION 51: For what reason would a rocketeer require an RCA?

- A: To legally purchase a motor from a vendor
- B: The purchase and launch a rocket motor
- C: To be legally allowed to transport explosive material. *
- D: To be legally allowed to store explosive material.

QUESTION 52: Which option (or options) apply to an “Acquire only” explosives certificate?

- A: Requires a registered store of relevant UN classes.
- B: Must purchase and use the rocket motors on site. *
- C: May purchase rocket motors via mail order.
- D: Must destroy any unused motors on site. *

QUESTION 53: Which option (or options) apply to an “Acquire and Keep” explosives certificate?

- A: Requires a registered store of relevant UN classes if storing over 5kg NEQ (net explosive content). *
- B: Must purchase and use motors certified motors on site.
- C: May purchase rocket motors via mail order. (Requires RCA for relevant UN classes.)
- D: Must destroy any unused motors on site.

QUESTION 54: What is the maximum amount of NEQ (net explosive content) that can be kept in a registered store.

- A: 10kg
- B: 15kg
- C: 2000kg *
- D: One M Reload

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- QUESTION 55:** What is a “registered store”?
- A: A registered Ammo box.
 - B: The entire property named on the registration. *
 - C: Your field launch box.
- QUESTION 56:** What is prohibited from being kept in a registered store if any other UN class of explosive is stored there?
- A: Any Combustible material. *
 - B: Petrol or any other flammable liquid. *
 - C: Black powder. *
- QUESTION 57:** Where are explosives certificates, registered store and RCA obtained?
- A: Registered store = Police, Explosives Cert. = HSE, RCA = Fire Brigade.
 - B: Registered store = Fire Brigade, Explosives Cert. = HSE, RCA = Police.
 - C: Registered store = Local Authority or Police, Explosives Cert. = Police, RCA = HSE or Police. *
- QUESTION 58:** Where may UN Class numbers for any item of interest to UKRA members be obtained?
- A: The manufacturer / distributor of the item. *
 - B: The Police.
 - C: The HSE.
- QUESTION 59:** There is an exemption for the requirement to obtain an explosives certificate if?
- A: You intend to fly all the motors on the day of purchase irrespective of total mass.
 - B: You will keep and store no more than 5kg net mass of propellant with 1kg single item limit. *
 - C: There is no exemption from explosive licensing.
 - D: You have held an RCA document within the past 10 years.
- QUESTION 60:** If a member wishes to fly a hybrid rocket motor they should?
- A: Launch at double the minimum safe distance for the motor’s rating.
 - B: Fly as normal – no special arrangements are needed. *
 - C: Fly at any distance they deem appropriate as the risk is reduced with no explosives in the motor.
- QUESTION 61:** When dealing with compressed gases, all cylinders must.....?
- A: Be periodically pressure checked and certified. *
 - B: Stored upright.
 - C: Transported by an approved carrier.

QUESTION 62: What is the main hazard of leaking compressed gas ?

- A: The lowering of atmospheric oxygen resulting in difficulty breathing.
- B: Risk of auto ignition once the gas mixes with air.
- C: Cold burns to exposed skin. *

QUESTION 62: What must all (non-experimental) hybrid rockets have ?

- A: The facility to allow the system to revert to a safe and depressurised state in the event of any sort of failure. *
- B: An electrically activated remote gas cut-off valve.
- C: A pressure gauge on the oxidiser feed line.

QUESTION 63: When assembling a hybrid motor, you should always ... ?

- A: Use the correct cryolube. *
- B: Check for damage / deformation. *
- C: Use a small amount of solid rocket propellant to get the motor started at ignition.

Diagram Sheet.

Symbol on rockets = C.G.

