



Examination Answer Books

12 Pages

Instructions to Candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.

1	Student Number	1810356
2	Title of Examination Paper	scientific principles of OME design
3	Module Code	ACDA 6008
4	Date and Time of Examination	5/5/22 11:00
5	Examination Venue	FF001
6	Seat Number	/
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	2
2	4
3	0
4	4
5	2
6	2
7	20
8	14
Total	48

- 1) Target structure
 Warhead size
 Material of liner and explosive composition

The penetration of a target is trying to impart enough energy from your warhead into the structure/armour.

Explosive needs to have a very high velocity ^{of} detonation to impart enough energy into the penetrator/fragments. Case thickness plays an important role as well as the case material. Having too thick a case with a lower performing explosive won't impart enough energy into the fragments for velocity and may only break up the case. The explosive must

Q1 = 2

- 2) A shaped charge jet works on a battle tank by on contact with the armour, the explosive detonates collapsing the cone and forming a jet and slug. The jet is in plastic-flow (hydrodynamic) and perforates through the armour and the slug follows. Typical jet speed ranges from 8-12 km/s while the slug is roughly 2 km/s. Battle tank use ERA to defend against SCT. This stops the formation of the jet as it interrupts the stand-off required for the jet to form. Tandem SCT warheads are employed to overcome ERA. The first SCT allows for the ERA to function and the second SCT can perforate the armour.

Q2 = 4

3) $A = \frac{F}{A}$ $A = \frac{F}{A}$ $F = ma$
 $A = \frac{350}{40} = 8.75 \text{ m/s}$ $A = \frac{F}{m}$

Q3 = 0

4) The blast wave is omni-directional. ✓

Wave lines, geometry of warhead, point of initiation ✓

Adding aluminum increases the brisance effect.

The aluminum adds to the energetic materials and increases the overall mass of energetic materials.

The blast overpressure is decreased but the energy impulse is increased over a longer duration. ✓

Q4
= 4

5) Dynamic loading - The combination of compressive shock waves into the structure.

Shock loading -

- Shockwaves bending around a structure and causing loading to the whole structure. ✓

Q5
= 2

6) Ballistic life is the length of time before the stabilizer has been consumed or the NC has degraded. ✓ Safe time in which the propellant can be used before degradation

- Storage conditions

- Stabilizer and other additives (cooling agents etc)

- Grain shape / size

Q6
= 2

7) Aircraft + submarine

- Due the difference in media they require different warheads to defeat the target. Water is only slightly compressible so fragmentation warheads are not as effective in water as they are at high altitude. Warheads to attack aircraft tend to have a payload no greater than 10Kg, this is due to the speed of the target. The warheads tend to be fragmentation warheads with the blast only used to project the fragments at high velocity where as submarines require a much larger warhead to deal enough damage. They focus on the blast causing compressive stresses within the hull of the submarine to cause catastrophic failure and breach the hull. Most warheads in the air domain use proximity fusing to ensure the fragments generated pass through the flight path.

Kinetic energy rounds are used against aircraft such as a continuous rod design. They travel at very high velocity and have direct impact with the aircraft of the flight path. Some contain a secondary blast / fragmentation warhead so when the KE round comes into contact with the aircraft it has secondary blast and fragmentation effects. A continuous rod design is a series of steel rods welded at one end which upon detonation create a ring shape which is fired into the path of aircraft.

Submarines tend to not be defeated by fragmentation warheads due to the loss of velocity of the fragments in water and the thickness of the side of a submarine. A torpedo is a blast warhead that when detonated on impact or close to the submarine causes a compressive shock wave to pass into the hull and oscillating bubble pulse to shortly follow after the initial over-pressure.

This bubble oscillates through the water and causes more shock loading into the submarine.

Emplaced mines and depth charges are another means of defeating a submarine and use the same principles of a blast warhead to create a shock wave and oscillating bubble pulse.

Fragmentation warheads are best used to defeat air targets and blast warheads in the air, waste most of their energy if they are omni-directional, the use of a frag warhead is more directional and more likely to cause the damage required. Aircraft don't require an instant kill and a small hole from a piece of fragmentation can cause a synergistic effect and the aircraft will pull itself apart.

Q7

=20

8) Gun propellants.

a)

Single base - NC matrix, typically 13-15% of nitrogen non energetic plasticiser, stabiliser, high α values and high flame temperature.

Double base - NC/NG base with Nitro or other energetic compounds used as the plasticiser. Stabiliser is carbamide.

Triple base - NC/NG base, Nitro as plasticiser, very high α values and high flame temp.

Single base used in SAA like pistols

Double base used in SAA like SMG's

Triple base used in tanks/artillery

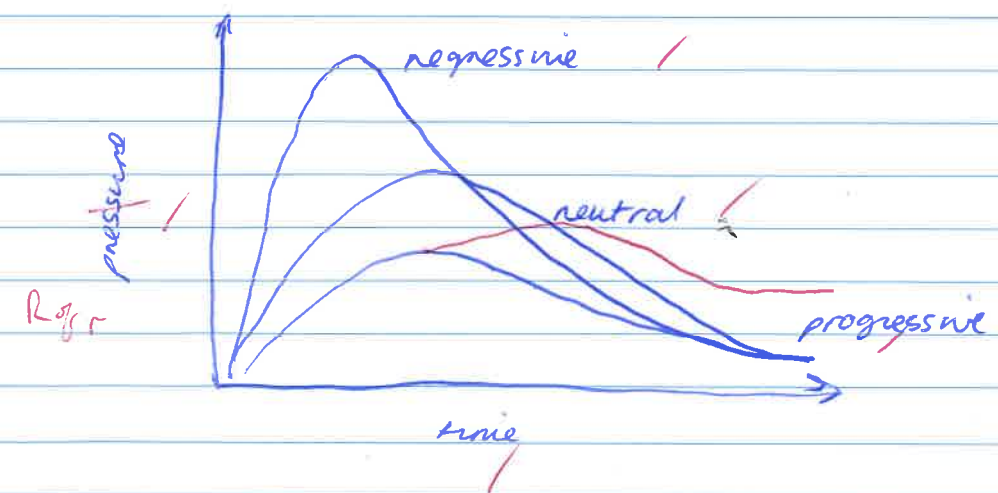
Composite - much like triple base but has the addition of up to 75% RDX.

High α values, lower flame temperature. More susceptible to shock and friction

Progressive burn rate - surface area increases while it burns. - Tubular / Multi tubular

Neutral - Uniform burn, surface area remains the same. - Ribbon / Flake

Regressive - surface area decreases when burning. - spherical / cylindrical.



Q8

=14

(6+2+8)

- b) - cheap ✓
 - low vulnerability ✓
 - predictable ignition temp / time
 - safe in a range of temps / conditions
 - No smokiness or muzzle flash, no barrel wear. ✓
 - Self extinguishing at barrel pressures not ambient. ✓
- i) NC degrades over time and can become very unstable ✓
 and can consume the stabiliser. NC is oxygen deficient so requires an oxidiser.
 LOVA ✓ has been developed, which is a low vulnerability ammunition.

Caseless cartridges have been used as the case is consumed with the propellant which can enhance the burn rate and requires not using brass. One down side is slow and fast cook off from the barrel temperatures.

Liquid propellants offer a better performance but require specialist storage tanks and some require a catalyst or means of ignition. Less susceptible to shock and friction but not as ~~easy~~ easy / quick to deploy than solid propellants.

NC based propellants cause unwanted degradation in barrels and without the addition of Ni₂ have a very large flash signature. The Ni₂ increases the N₂ production so decreases muzzle flash / noise.