



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 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	1810310
2	Title of Examination Paper	Scientific Principles of GME
3	Module Code	ACDA6008
4	Date and Time of Examination	11.00 5-5-22
5	Examination Venue	FFG01
6	Seat Number	
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	3.5
2	2.5
3	0
4	4
5	2.5
6	3
7	26
8	8
Total	49.5%

- 1 Penetration of a warhead is Governed by its density and velocity of its component in contact with the target i.e. fragment the target material. Density will also effect and Velocity will also Affect Penetration (5.5)

Q1 =
3.5

to maximise fragment Velocity from the warhead case the Density of the explosive fill is most important performance is Best when more fragments hit the target so timing and Distance of initiation is Crucial

- 2 A shape charge Jet (SCJ) when employed against a Tank will often be used to attack the top of the tank. the SCJ will be initiated at an adequate stand off toward the tank it is often tanks will employ Counter-measures such as Explosive Reactive Armour (ERA) or NON ERA (NERA) to disrupt Jet formation a tandem or dual warhead can be employed to overcome this the first warhead will combat Countermeasures followed by hydrodynamic Penetration from the latter, usually Bigger warhead

Q2 =
2.5

3

$$1. \quad F = ma \quad F = (600 - 350) = 250$$

$$M = 40$$

Q3 =
0

$$a = \frac{F}{m} = A = 6.25 \text{ ms}^{-1}$$

2

$$\cancel{F = ma} \quad \cancel{\frac{F}{a} = m}$$

4

a centrally initiated spherical charge will have a shockwave that uniformly propagates outward from the Point of Detonation ✓

Factors that affect Blastwave from other shapes of charge are point of Detonation ✓ and the complexity of the shape being detonated i.e. edge effects

Adding Aluminium to an underwater explosive will extend the Impulse of the Detonation ✓, the charge will detonate then Aluminium will be consumed slower than the initial shock and Blast giving longer and greater magnitude shock and Dynamic impulse

5

Shock Front - the shock hits the structure either as a single or Coalesced wave such as found with a Mach stem or other Reflection leading to distortion

Dynamic loading - the structure is subject to positive and negative loading

Response - the structure yields according to the effect of the Blast and likely collapsing

6

Ballistic life is the Period of time a Propellant retains its ability to be used safely and not suffer from autocatalytic Decomposition ✓

Q4
=46
Cont

the factors that influence a Propellant's Ballistic Life are

Stabiliser content ✓
Migration of Components ✓
Aging of materials ✓

7
a

Lethal Mechanisms for the attack of AN Aircraft can be by way of Direct or indirect attack

Suitable method to Neutralise AN Airborne target Directly can be

Internal Blast where a warhead will ~~penetrate~~ Perforate the light skinned Airframe prior to detonation or shaped charge / Kinetic Energy weapons that will damage the Airframe resulting in failure due to stresses caused by the environment (unless Pilot / Fuel tank Hit)

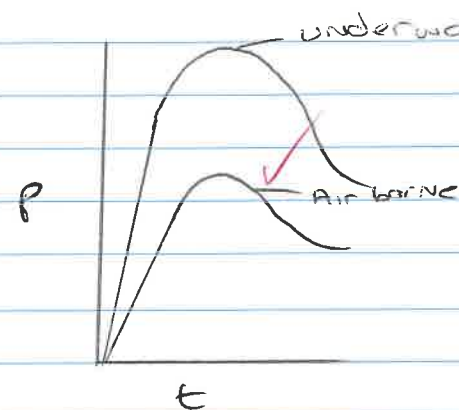
The most effective way to Neutralise AN Aircraft is Indirectly with the use of a Preformed Fragmentation warhead these create a working Volume that can Disrupt the airframe and Neutralise it, the Best example of this is a continuous Rod warhead that effectively launches a Ring of metal at the aircraft.

external blast is combatted by distance (inverse square law) so internal blast is the only achievable way to Neutralise airframes however due to constraints of getting the warhead to the target it limits the size of the warhead

Q6 =
3Q7 =
12

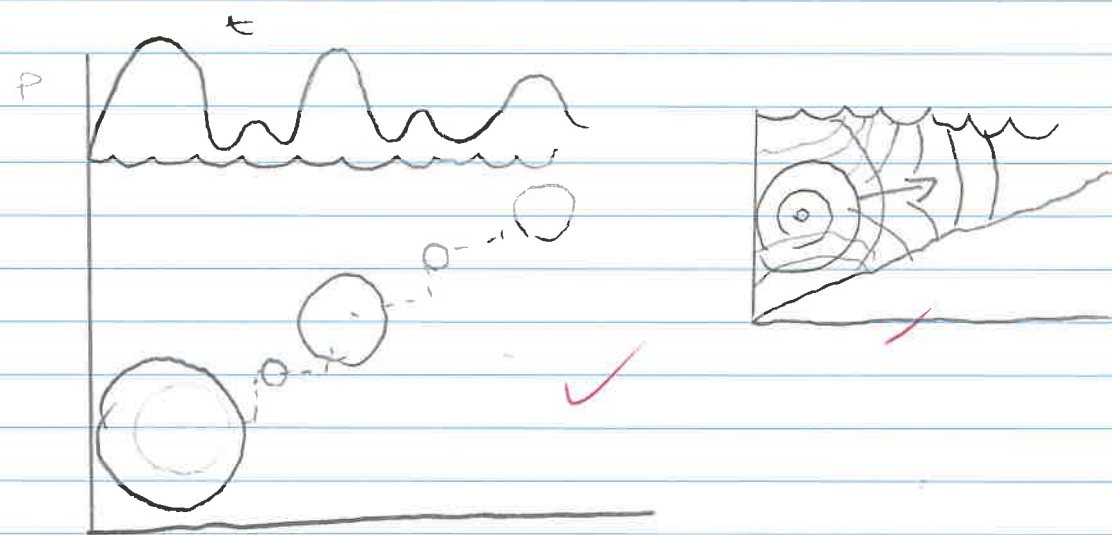
Ta
cont to ~ 10 's of Kg ✓ with Directed energy weapons and KE Rounds like NLAW? and Javelin? the warhead size is ^{Anti-Aircraft} proportional to deliver the desired effect when considering fragmentation warheads due to Velocity of the warhead energy is only again Required to give the desired effect in Respect of the size of the Damage Volume Required. Considerations must be given to Altitude effects ✓

b Lethal Mechanisms for the attack of Submarines can be by way of Directed energy torpedoes in direct contact with the Boat as is used in 'Stingray' ✓ But more often than not is by way of a Blast warhead Initiating the Bubble Pulse effect these warheads can be delivered by Sea Mine, Depth Charge or torpedo ~~although~~ Generically speaking charges to be used Underwater are Aluminised to extend the impulse of the Blast and increase its magnitude of output, given the relative incompressibility of water when compared to Air At high altitude this steepens the shock front delivery to the vessel due to the sonic speed of water ✓



Fb
cont.

being around 1500 ms^{-1} and Air Approx. 330 ms^{-1} . ✓ these large Blast warheads invoke the bubble pulse effect which causes cyclic loading referred to as whipping to the hull ✓ of the Boat, this whipping causes massive disruption to people plant and systems in the vessel as well as taking advantage of Prestressed or weakened parts of the vessel causing it to yield. the Bubble will migrate upwards as it expands and contracts.



with each cycle energy will be absorbed by the water and so will become successively smaller until surface break when employed in shallow water the shock front will coalesce ~~and~~ from reflection taken from both surface and seabed ✓

these large Blast warheads as used in mines Depth charges and Torpedoes such as spearfish have warhead sizes in the order of 100's of Kg. ✓

Q7b
=14

14

total
= 12 + 2 = 14 ✓

~~8/4~~

Gun Propellants

Do NOT
MARK

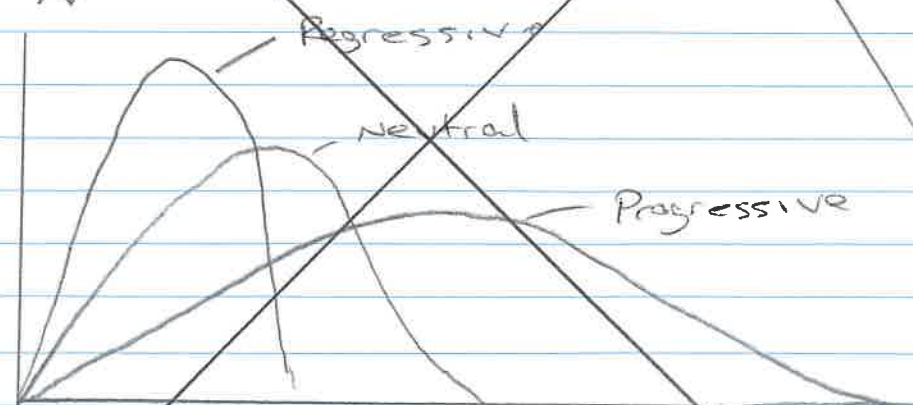
Single Based - nitrocellulose (NC)

Double Based - NC 13.5% Nitroglycerine (NG)

Triple based - NC 13.5% NG + Nitroguanidine (NGU)

High Energy Nitramine - NC 13.5% NG + (RDX or [RDX/NGU])

grain shape takes a major stance on performance of a gun propellant and can be set into three categories

Regressive - where grain is solid and has no complex features
Neutral - where a simple feature like a slot or hole is employed
Progressive - Multihole or complex shape


with the application of different grain types it can be assumed that the greater the surface area the greater the burn rate (Vieljeux / Probert)

~~8/6~~desirable properties of next generation Gun ~~propellant~~ Propellants are:Do not
mark

Safe to handle/transport (Cova)
Caseless
Stable

NC Based gun propellants are subject to high unreliability degradation and

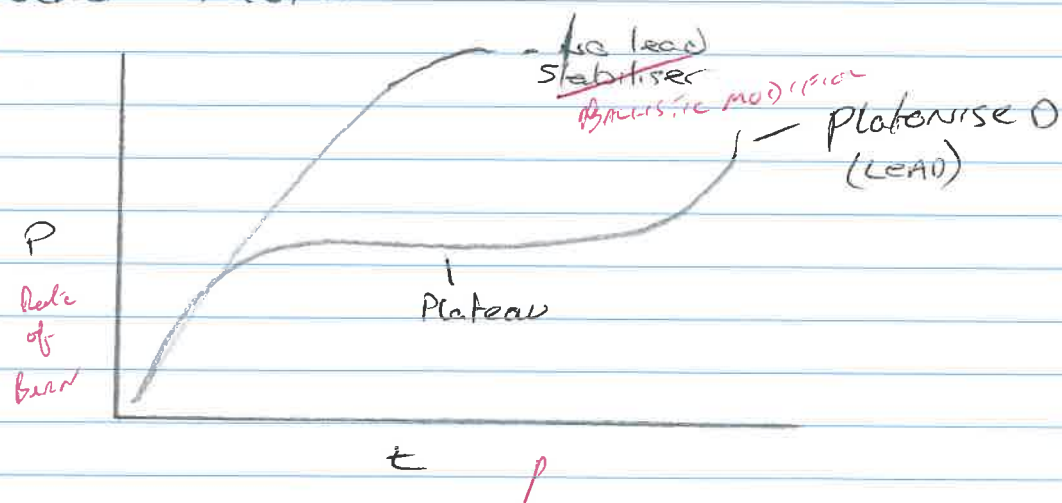
Do NOT MARK any of Question 8

9a

Liquid mono propellants work in low O_2 Atmospheres and require some kind of interference to get them initiated they are simplistic and cheap in design. Liquid bipropellants are more complex they will have to hold two or more liquids in separate tanks to ~~ascertain~~ prior to a ratio in chamber mixer order to ascertain Hypergolic ignition where the components of the Bi propellant will ignite on contact.

b Liquid Propellants are easier to store and maintain when compared to solid Fuel Rocket motor the main reason for this is the consumption of the Rocket motor stabiliser which when enough has been consumed will lead to Autocatalytic Decomposition.

c Platonisation is the method of stabilising and modifying the Burn rate of a solid fuel rocket motor.



Platonisation allows for a Predictable Burns of the motor that produces less wear on the nozzle however in spite

9c
Cont

of having the Advantage of a slightly longer Burn time it does reduce the overall energy output from the motor.

d

~~Rubbery~~ ~~ce~~

Q9a
= 5

Q9b
= 1

Q9c
= 2

9 Total
a+b+c+d
5+1+2+0
= 8