



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Complete, fold and seal
(see note 2 below)

SURNAME: Lane

FORENAME(S): Emma

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 read your script or have it typed and the expense of typing charged to the candidate.
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1	Student Number	2313851
2	Title of Examination Paper	Principles of OME
3	Module Code	ACDA 4019
4	Date and Time of Examination	8-01-2025 1200hrs.
5	Examination Venue	UWTSD 12310
6	Seat Number	028
7	Number of Answer Books handed in	1.

List the numbers of the questions you have attempted	Office Use
1	0
2	7
3	5
4	6
5	2
6	4
7	2
8	0
9	0
10	0
Total	26

- Q1 The size of the charge diameter can have an effect on the velocity of detonation, if you have a small diameter the charge will burn quicker over a shorter time so at the target the munition might not have the energy to penetrate.

Deflagration is the ignition of the explosive train to detonation



Q2a

Explosives

High Explosives	Low Explosives
primary secondary	propellants pyrotechnics

b. Primary Explosives - Lead azide or Silver Azide

Secondary Explosives - TNT or RDX

Propellants - Nitrocellulose or Nitroglycerine

Pyrotechnics - Magnesium or potassium nitrate

Primary explosives used at start of explosive train easy to ignite

Secondary explosives normally used as main filling slightly harder to ignite than primary

Propellants - ~~used to~~ give off large quantities of hot gas

Pyrotechnics - produce light or sound

2c. it failed to detonate because there was not enough heat and energy produced.

1

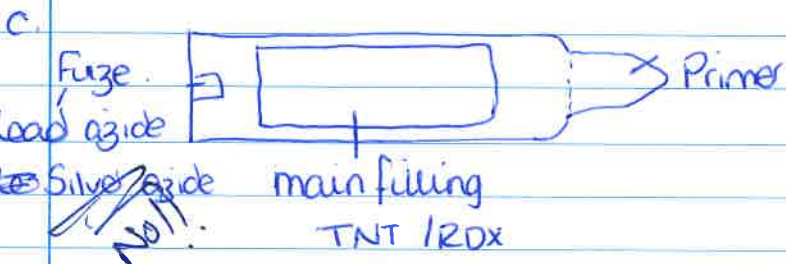
7

Q3a Critical Diameter is the size of the charge needed to sustain the shock wave. Critical Density is how much filling is needed to sustain the shock wave.

1

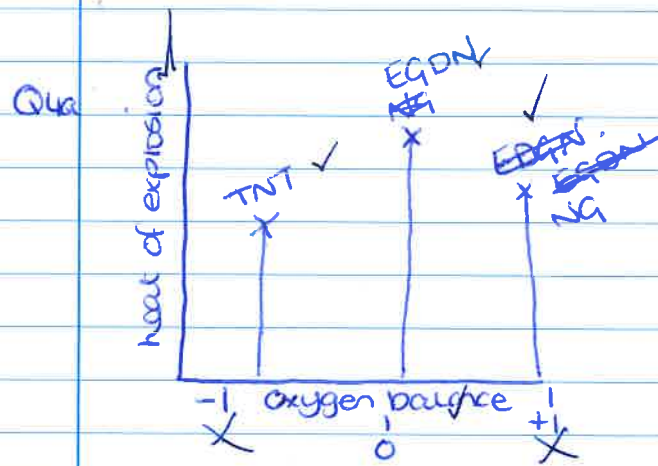
b. If the critical diameter and density are lower ~~than~~ ^{or higher} than expected the munition will not function as intended.

1



3

5



2

b. TNT has a negative oxygen balance so produces more carbon.

1

c. Given EGDN has an oxygen balance of 0% you would expect it to give of a mix of ~~carbon~~ $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{g})$.
→ High energy release

2

d. If aluminium was added to an explosive it would produce heat. The heat of explosion and gas volume would increase.

1

6

Q5a A 'hot spot' is a cavity or void where when pressure is added the energy levels increase causing unstable levels of heat.

1

In TNT the crystals can crack or have open voids meaning more surface is available so the ignition temperature doesn't have to be as high as normal.

b. The constant heating and cooling of the TNT could have caused cracks in the TNT. With more surface area to burn the crystals burn quicker than expected causing premature explosion. *melting + recrystallisation*

1

2

Q6a. Single base - Nitrocellulose
Double base - Nitrocellulose + Nitroglycerin
Triple base - Nitrocellulose + Nitroglycerin + Nitroguanidine

2

b. The maximum theoretical percentage is 14.14% ^{for nitration} for nitrogen. _{13.4 for SB propels}

c. You could add RDX to the propellant however this would decrease the barrel life due to increased wear and tear from extra force and heat.

2

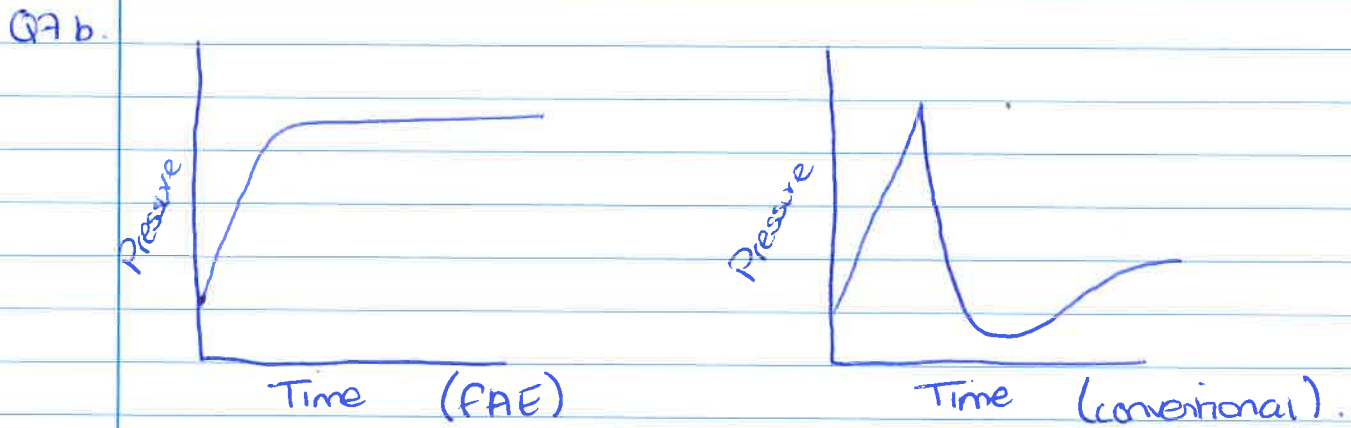
d. You could add a coolant such as DNT.

X

0

4

Q7a ~~The explosive train~~ ^{initiate} The fuze burns to the main filling once the main filling has burned ~~at~~ the primer is initiated along with the booster. The explosive mechanism is fragmentation. This allows for maximum damage however can produce unwanted collateral damage.



a. An FAE explosive train starts rapidly burning the primary ^{then} ~~the~~ secondary explosive using the atmospheric oxygen to propel itself once the explosives are burned out it stays on a steady trajectory. The explosive mechanism is fragmentation. This allows for maximum damage to the target, however allows for potential collateral damage.

Q8a. ^{A.} Projectile ~~B~~ is more likely to penetrate further as has less surface to surface contact so the kinetic energy can keep the forward momentum going longer.

b. The second projectile ~~the faster fire~~ will be more likely to penetrate as it is more stable in flight to keep the momentum the fuze has longer to burn before reaching the ~~secondary~~ main filling so it will be closer to the target with more energy to penetrate the armour.

↑
After Q10.

Q9a A gasless delay is the time between burning and explosion where the chemical is burned out and not producing gas. A gassy delay is where the chemical keeps burning before ~~the~~ until the ~~explosion~~ combustion.

b. Gassy delay - flares.
Gasless delay - fireworks.

c. If the pyrotechnic has too much conductivity then the chemicals become unbalanced and more sensitive to heat which could cause premature. If it is too porous then the chemical can't contain enough heat and energy to work as intended.

Q10a The blue flare has a really quick burn time so is unlikely to be seen ^{less intense} as the wavelength is short. The red flare can burn for a lot longer so it is easier to see as the wavelength is longer ~~rather~~.

b. We need different combustion regimes for due to what the product is being used for.
example: - flare is normally used to pinpoint a location so needs a long combustion time ~~however~~ within the spectra. However soldiers using ~~red~~ wanting to see where their rounds are going are better with a quicker combustible off the spectra so enemy can't see.

Q8a. Projectile A^X is more likely to penetrate as the charge is smaller so has a quicker burn rate and less energy ~~at~~ by the time it reaches target $\rightarrow$ same velocity! ^X

0

b. The first projectile as ~~the~~ it has a dense main filling^X giving it a longer burn rate and will gain ^{3rd} momentum and energy as it gets closer to the target. This will allow the kinetic energy to be transferred to the armour for penetration.

0

1

0



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1	Student Number	2313852
2	Title of Examination Paper	Principles of OME
3	Module Code	ACOA 401A
4	Date and Time of Examination	08/01/2025 1200 hrs
5	Examination Venue	310
6	Seat Number	029
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	0
2	7
3	5
4	6
5	4½
6	2½
7	2
8	2
9	0
10	1
Total	30

(Gweler yr ochr arall am y fersiwn Cymraeg)



Question No.

Examiner Only

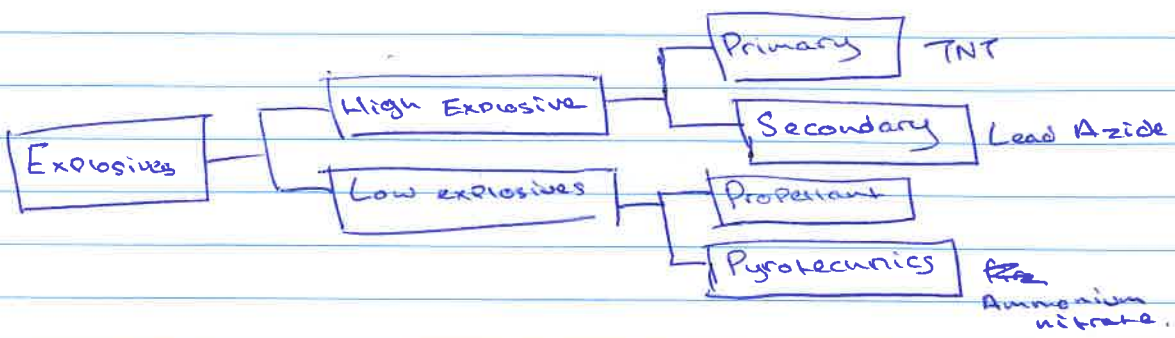
(ia) Deflagration to detonation.

Arholwr yn unig

Rhif y Cwestiwn

0

(2a)



3

(2b)

High explosives - Rapid decomposition of reactant and detonation occurs at supersonic speed. (eg, RDX, TNT, Lead Azide)

Low explosives - Sustained decomposition, leading to deflagration, occurring at a subsonic speed. (eg, gunpowder, Ammonium Nitrate).

3

(2c)

ANFO relies on high energy in order to completely combust, as it has.

1

(3a)

Critical diameter - The minimum diameter necessary in order to sustain a detonation shockwave.

1

Critical Density - The minimum density of explosive particles necessary in order to sustain a detonation shockwave.

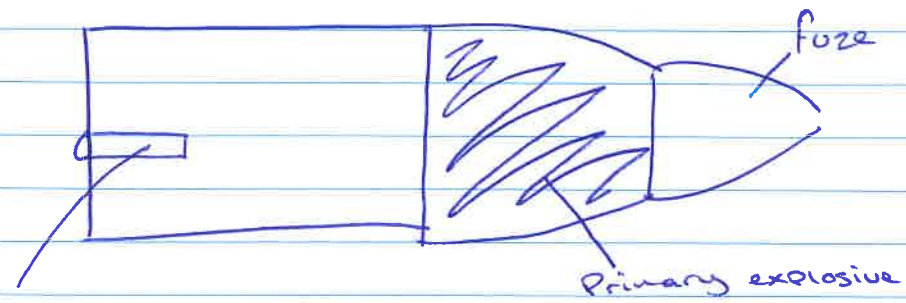
1

(3b)

As they directly influence performance of the munition, releasing the necessary amount of gas, temperature and energy -

2

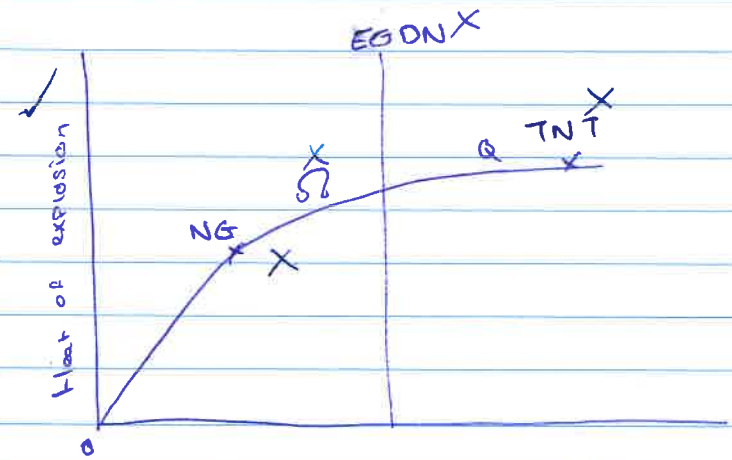
(3c)



1

5

(4a)



1

(4b)

Low oxygen Balance, incomplete combustion.

1

(4c)

Oxygen balance is neutral so you would find:
Carbon Dioxide (CO_2) ✓
Water (H_2O) ✓
gas $\approx$ Nitrogen. (N_2) + high energy

2

(4d)

- Produce Aluminium Oxide (Al_2O_3) ✓
- heat of explosion would increase as Aluminium is exothermic, resulting in higher energy released due to more pressure
- Gas Volume increases ~~because~~ as there would be a bigger detonation resulting in more energy and more gas.

1

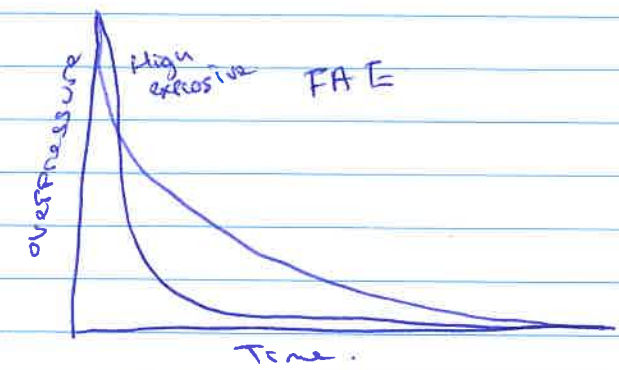
1

6

6

~~(5a)~~ ~~An area where the temperature is higher than surrounding areas.~~ (5a) - An area within explosive material where the temperature is higher than surrounding areas. - It increase the temperature in surrounding areas allowing maximum detonation due to higher energy released. - Thermal Hotspot - Chemical Hotspot - Ignition Temperature is	1 2 0	(6a) Single = Nitrocellulose (NC) = everything X double = Nitrocellulose (NC) & Nitroglycerine (NG) = ~~small~~ ^{small} arms weapons! Triple = Nitrocellulose (NC) & Nitroglycerine (NG) & Nitroguanidine (NQ) = M30 (6b) - 13.9% 13.4 - Nitrogen will decrease [↑] the force constant as it is an imperfect additive resulting in less energy released. - Nitrogen will decrease [↑] the flame temperature resulting in less energy at detonation. (6c) - Aluminium could be added. ~~NOX~~ - Aluminium is exothermic, ~~when~~ when reacting with Oxygen creates Aluminium oxide, resulting in more gas pressure, meaning more energy being released allowing increased velocity. (6d) Anti heat alloys. Chromeplatin (7a) explosive train - where explosive reacts and detonates allowing others nearby to detonate. Explosion mechanism - it works by rapid decomposition where the flame travels at a supersonic speed. advantages are it can easily hit and destroy targets. disadvantage if it does not hit target, detonation time is unknown.	2 0 1/2 2 1/2 0 pts
~~(5b) Metal shell~~ (5b) ~~The chemical formation of the TNT could change causing cracks, increasing the sensitivity of TNT causing accidental firing.~~ but looking for melting and recrystallise - Metal casing ~~could~~ expand or contract due to varying temperature, resulting in damaged explosives which could be dangerous. - failure to inspect before firing as it is stored in ~~varying~~ ~~temp~~ temperature could lead to misfiring in the barrel. - leads to degradation.	2 1/2 4 1/2		

(7b)



2

(2)

(8a)

~~Projectile A will penetrate further due to it having more force.~~

Projectile B ✓ as it is smaller, Projectile A will have more force against it as the diameter is larger than B, where as B is more compact therefore completing more damage and distance.

2

(8b)

~~The top projectile~~ ✓ due to the Basistic cap allowing to wedge in the armour, ~~meaning more energy~~
- due to the shape of the projectiles, it seems as if the bottom one will stop at a certain point, whereas the top is shaped that if there is enough energy & force it ~~will~~ could possibly go all the way through.

- The top Projectile also has an inner sheath allowing it to have a stronger core resulting in the projectile having less damage than the bottom.

0

(2)

(9a)

Gasless often occurs when water is a reactant in a delay, resulting in no gas being visible at delay. ✓
gassy occurs when ~~they~~ there chemical substance only involved.

(9b)

gassy - when there ~~are~~ is a bigger detonation ✓
gasless - ~~less~~ smaller burn.

(9c)

(0)

Examiner Only

Question No.

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Question No.

(10a) - Using the data Red (Strontium) burns at a higher temperature than Blue (Copper salt).
- Red also uses more energy as it burns hotter and releases more ~~extra~~ energy than blue as shown.

1

0

1

Rhif y Cwestiwn

Arholwr yn unig

Rhif y Cwestiwn

Arholwr yn unig