

Interactive Example Candidate Responses

Paper 4 (May/June 2016), Question 1

Cambridge International AS & A Level

Biology 9700

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- 1 (a) ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Fig. 1.1 represents the molecular structures of ATP and NAD.

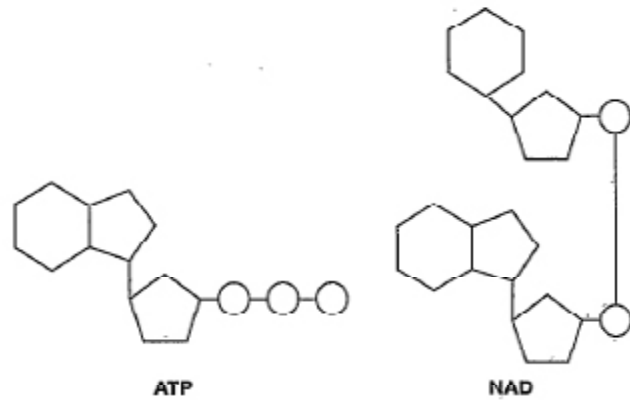


Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP contains one nitrogenous base (adenine) while NAD has two nitrogenous bases, one purine and one pyrimidine. ATP has three phosphate groups while NAD has two. ATP has one pentose sugar (ribose) while NAD has two pentose sugars.

[3]

Your
Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1	Mark scheme
(a)	<p>both have <u>ribose</u> (sugars) ; R ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; 1 ref. to additional hexose both have, adenine / purine (base) ; 1 adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ;</p> <p>[max 3]</p>
(b)	<p><i>accept synthesise / produce / convert to, for 'make' for all mp</i> make (named), protein / polypeptide / peptides ; A protein synthesis / translation make (named), disaccharide / oligosaccharide / polysaccharide / glycogen ; R nonmammalian examples such as starch or cellulose make (named), triglycerides / lipids / phospholipids / steroids / cholesterol ; A glycogenesis make, nucleotide / polynucleotide / nucleic acid / DNA / RNA ; A transcription / DNA replication AVP ; e.g. named example of, polymerisation / condensation A phosphorylation example</p> <p>[max 3]</p>
(c)	<p><u>substrate-linked</u> / <u>substrate-level</u>, <u>phosphorylation</u> ; I condensation reaction</p> <p>[1]</p>
(d)	<p>hydrogen, carrier / acceptor ; A gets reduced or gains H / H⁺ <u>and</u> electrons I donates R H₂ / hydrogen molecules (acts as a) coenzyme ; A enables dehydrogenases to work ref. to glycolysis / respiration in anaerobic conditions ; A anaerobic respiration I aerobic</p> <p>[max 2]</p>
(e)	<p>'more' needed once plus implied for second mp 1 more, C-H bonds / hydrogen(s) / reduced ; 1 C-C bonds R more hydrogen bonds R hydrocarbons <i>accept produces / gives / results in for 'makes' in mp 2 and mp3</i> 2 (makes) more reduced NAD ; 3 makes more ATP per, gram / molecule / mole / unit mass ; A releases / results in / gives, more energy per, g / etc. 4 more, aerobic respiration / electron transport chain (ETC) / oxidative phosphorylation / chemiosmosis ; A higher rate of for 'more'</p> <p>[max 2] [Total: 9]</p>

- (b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a mammal that require ATP as an energy source.

- 1 DNA replication
2 protein synthesis [2]

- (c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

..... substrate level phosphorylation [1]

- (d) Outline the roles of NAD in the cytoplasm of a cell.

NAD is a hydrogen carrier. It accepts hydrogen from glycolysis in cytoplasm and become reduced. NAD then transport it to oxidative phosphorylation in (inner) mitochondrial cristae. [2]

- (e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value/kJg ⁻¹
carbohydrate	15.8
lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

Lipids have a higher caloric value as they have more C-H bonds, so more hydrogens are released. So more reduced NAD are available for oxidative phosphorylation. Most ATP synthesized is during oxidative phosphorylation. [2]

[Total: 10]

Your
Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1 Mark scheme

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- 1 (a) ATP and NAD both play important roles in respiration. Both compounds are nucleotides.

Fig. 1.1 represents the molecular structures of ATP and NAD.

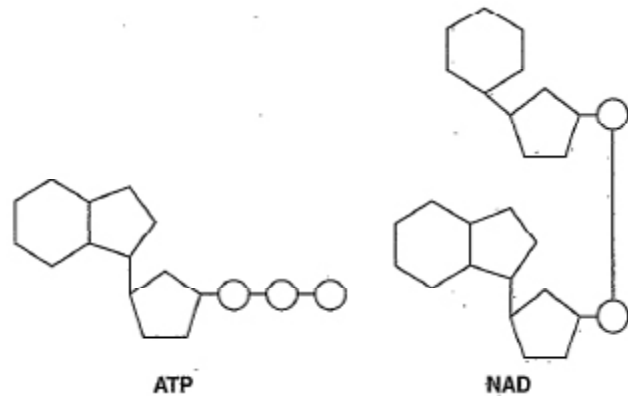


Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP is made up of one ribose sugar, a nitrogenous base which is a purine and is also known as Adenosine triphosphate. The ribose sugar is bonded to three phosphate groups.

NAD is made up of two ribose sugars, two nitrogenous bases: a purine and pyrimidine. The two ribose sugars are bonded to a single phosphate group, each to a single phosphate group. The two phosphate groups are linked together.

[3]

Your
Mark

1(a)

1(b)

1(c)

1(d)

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Q1	Mark scheme
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- (b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a mammal that require ATP as an energy source.

- 1 ~~Active transport~~ Creatine Phosphate formation
Active transport of minerals and ion into the cell.
 2 ~~Muscle contraction~~ B. M. Acetylcholine ~~Cysteine~~ ~~Galanin~~ ~~Glutamate~~ [2]

- (c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

Chemiosmosis [1]

- (d) Outline the roles of NAD in the cytoplasm of a cell.

NAD provides hydrogen for oxidative phosphorylation in the form
of reduced NAD, the hydrogen is used to provide energy for ATP synthase.
NAD is used to synthesise dopamine
 [2]

- (e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value/kJ g ⁻¹
carbohydrate	15.8
lipid	39.4

- Explain why lipids have a higher energy value than carbohydrates.

Lipids have a higher energy value than carbohydrates because the
contain more carbon and hydrogen per molecule than carbohydrates.
The higher the number of hydrogen atoms present the more ATP is
synthesised.
 [2]

[Total: 10]

Your
Mark

1(a)

1(b)

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Q1 Mark scheme

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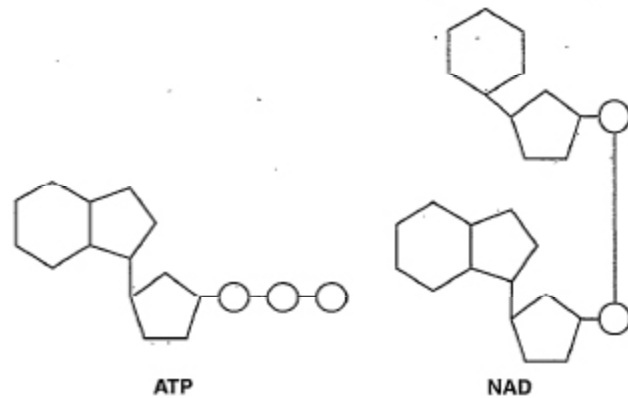


Fig. 1.1

Using Fig. 1.1, compare the structures of ATP and NAD.

ATP, has ribose sugar and Adenine,
Nitrogen containing base is attached to
Carbon number 5 and three phosphate
group are attached to carbon number one,
NAD is a co-enzyme have phosphodiester
bond and have two different types monomers
of Nitrogen containing base and one
phosphate group.

[3]

Your
Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1	Mark scheme
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- (b) ATP provides an immediate energy source for metabolic processes such as anabolic reactions.

State two examples of anabolic reactions in a **mammal** that require ATP as an energy source.

- 1 muscle contraction
2 reabsorption in kidneys [2]

- (c) Name the type of chemical reaction by which ATP is made during the Krebs cycle.

light independent reaction [1]

- (d) Outline the roles of NAD in the **cytoplasm** of a cell.

NAD is co-enzyme
NAD is used to take hydrogen during
hydrogenation to be reduced NAD
[2]

- (e) Carbohydrates and lipids are used as respiratory substrates.

Table 1.1 shows the energy values of carbohydrates and lipids.

Table 1.1

respiratory substrate	energy value/kJ g ⁻¹
carbohydrate	15.8
lipid	39.4

Explain why lipids have a higher energy value than carbohydrates.

lipids have higher hydrocarbon bond than
and more carbonyl carbons
more bonds are broken during hydrolysis
[2]

[Total: 10]

Your
Mark

1(a)

1(b)

1(c)

1(d)

1(e)

Q1 Mark scheme

(a)	both have <u>ribose</u> (sugars) ; R ribulose ATP has 1, ribose / pentose / sugar, NAD has 2 ; 1 ref. to additional hexose both have, adenine / purine (base) ; 1 adenosine NAD has, nicotinamide / pyrimidine (base) ; ATP has 3 phosphates, NAD has 2 ; [max 3]
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