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A2 Biology OCR

Unit F215: Control, genomes and environment

Module 2.2 Biotechnology

Answers

5.2.2

1

(a) **B;**

C;

D;

A;

4

(b) (i) *award two marks if correct answer (26.18 / 26.2 / 26) is given*

$$24 \times 60 = 1440 \div 55;$$

26.18; **A** 26 / 26.2

2

- (ii) less oxygen / *ora*;
 reduced amount of nutrients / *ora*;
 ref to pH / *ora*;
 competition from other bacteria / interspecific competition / *ora*;
 use of antibiotics;
 AVP; ref to intestinal enzymes or immune system
R reference to temperature
treat toxins as neutral

max 3

[9]

2

- (i) (penicillin) secondary metabolite ;
 produced at start of / during stationary phase / end of growth phase ; **A** log
 phase ref to production (at maximum) when kept short of nutrients
 / nutrients depleting / factors limiting growth ;
 continuous culture maintains in, log / rapid growth, phase ;

2 max

- (ii) to provide respiratory substrate / energy ; **A** for respiration
 to maintain culture / keep culture alive / prevent (premature) death of
 culture ;
 (limited) maintains in stationary phase / prevents rapid growth ;
 AVP ; **R** glucose as carbon source

2 max

[4]

3

- (i) type of starch ;
concentration of, starch / suspension ;
 volume of, starch / suspension ; **R** amount
 ref to flow rate ;
 size of beads ; **A** number / mass / volume, of beads in column **R** amount
 temperature ;
 length / diameter, of column ;
 yeast concentration ;
 pH ;
 AVP ; e.g. age of culture

3 max

5.2.2

- (ii) add Benedict's (reagent) and, boil / heat ; **A** CuSO₄ in alkaline solution
different, densities / colours (of precipitates) formed ; **A** turbidities
use of a colorimeter in correct context ;
A filtering and weighing precipitate

OR

use of Clinistix / Diastix (strips) ;
different colours obtained ;
colour compared to chart ;

accept other valid methods e.g. reference to use of biosensors

2 max

- (iii) *agree*
not all yeast cells successfully entrapped / AW ;
(in product) yeast cells, respiring / metabolising / using sugar as an
energy source ;
(so) lower levels of sugar (in product) ;

not agree

yeast cells, entrapped (in beads) / immobilised, so product not contaminated
/ yeast not present to affect product ;

yeast cells unable to pass through, glass wool / filter ;

only very low numbers of yeast cells (so unlikely to have great effect) ;

2 max

[7]

4

award marks if diagram clearly annotated

reservoir for storage of nutrients ;

ref to method for addition of nutrients and removal, of waste / products ;

A substrate

ref to more detail of, nutrient addition / product removal, at a constant rate /
continually / throughout fermentation period ;

idea of rate of product removal equal to addition of nutrients ;

A keep volume constant

use of probes / sensors / monitors ; **A** thermometer (for temperature)

(to monitor) any two of, temperature / pH / oxygen levels ;

method to maintain pH e.g. use of buffers, tube to add acid / alkali ;

addition of antifoam ;

ref. to need to maintain sterility (to avoid contamination) ;

method to maintain constant temperature e.g. (thermostatically-controlled) water
bath, cooling jacket ; **R** heat exchanger

AVP ; e.g. use of stirrer, method to avoid, clumping of cells / blocking of inlet or
outlet pipe(s)

max

4

[4]

5

- (a) (i) penicillin; **A** other named antibiotic 1
- (ii) (complex organic molecules) produced after / not produced during, the (log / rapid / main) growth phase; not essential for normal, cell growth / reproduction; max 1
- (iii) batch / fed batch; 1
- nutrients only added at start;
short / rapid, growth phase;
required product made, during stationary phase / late in life cycle; ora
- R** death phase
- shortage / depletion of, nutrients / named nutrients;
cell division / reproduction, no longer occurring;
ref to addition of, glucose / lactose, at intervals
(to avoid death of culture); max 2
- (b) 1 air pressure will push the medium into the culture vessel;
2 medium / nutrients, added to the culture at a constant rate / AW;
3 algae / cells / *Chlorella*, removed / harvested, from the sample port;
4 at the same rate as / to match, the nutrients added;
5 so volume in fermenter remains constant;
6 removal of, waste / toxic products;
7 that could affect, growth / reproduction;
8 (cells kept in) exponential / log / rapid / main, growth phase;
9 algae are photosynthetic;
10 light energy required;
11 ref to use of fluorescent light to avoid overheating;
12 ref to monitoring temperature;
13 ref to optimum conditions; **A** 'conditions for maximum growth'
14 air bubbles to mix culture with nutrients / AW;
15 air bubbles to allow algae to get sufficient light;
16 air bubbles provide oxygen for (aerobic) respiration;
17 and CO₂ for photosynthesis;
18 air flowing into the culture vessel flows out through an outflow tube;
19 preventing build-up of pressure;
20 AVP; e.g. sampling to check for mass of *Chlorella* max 6

5.2.2

(c)

difficulty maintaining a constant temperature; } one mark for ref to difficulty of
 difficulty maintaining a constant pH; } controlling environmental factors

heating / cooling, qualified;

foaming;

blocking of, inlet / outlet, tubes;

difficulties with, mixing / stirring;

contamination / keeping it sterile;

conditions need to be continuously monitored;

nutrient requirements may change;

AVP;

AVP; e.g. algal growth on glass

difficulties in providing sufficient light

errors lead to loss of several days production of *Chlorella* max 4

[15]

6

- (a) (i) amylase; 1
 (ii) glycosidic; R glucosidic 1
 (iii) alpha / α ; 1

- (b) (i) encapsulation / trapped in alginate beads;
 adsorption *or* stuck onto, collagen / clays / resins;
 cross linkage or covalent / chemical bonding to, cellulose (fibres);
 gel entrapment / trapped in silica gel;
 partially permeable membrane microspheres; max 2

- (ii) does not mix with / does not contaminate / stays separate from, the
 product; ref to, no / less / easier, downstream processing;
 recoverable / not lost during processing;
 reusable / cost effective;
 matrix stabilises / protects the enzyme;
 so activity not affected by changes in, temperature / pH *or* run at
 a high temperature / wider range of pH;
 longer, use / shelf-life;
 so suitable for continuous culture / cost effective / greater yield;
 AVP;
points can interchange if valid max 4

5.2.2

- (c) not necessary to start with a pure enzyme;
keeps the enzyme away from oxygen;
more enzymes involved;
cell produces enzymes;
AVP; e.g. enzyme(s) may be, expensive / difficult to isolate
simultaneous processes can occur

max 2

[11]

7

- (i) *max 1 for meaning of term*
attached to an insoluble material / AW;

max 2 for description

(micro)encapsulation / (trapped) in alginate beads;
adsorption / stuck onto, collagen / clays / resin / (porous) glass;
cross linkage / covalent / chemical, bonding to, cellulose / collagen fibres;
gel entrapment / trapped inside gel e.g. silica (lattice / matrix);
partially permeable membrane (polymer) microspheres;

3

- (ii) *any three from the following:*

urine can be processed / no problem of removing urine / AW;
pure / drinkable / useable, water produced; **A** water recycled
space saving / less water needs to be taken into space;
payload limit / weight reduction / AW;
no problem in separating enzyme from products / product not
contaminated;
ref. to longer shelf-life of enzyme;
no need to take more enzymes into space / enzymes reusable;
A enzymes recoverable

AVP; e.g. larger surface area of enzyme exposed, more stable at
extremes,
ref. to ease of use (of bioreactor)

3

[6]