

# Interactive Example Candidate Responses

## Paper 2 (May/June 2016), Question 3

### Cambridge International AS & A Level

### Biology 9700

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- 3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.

All six countries are classified as low-income countries.

Table 3.1

country	population in 2009	number of cases per 100 000 people			
		2009	2010	2011	2012
Central African Republic	4266 000	0.26	0.05	15.31	3.12
Chad	11 371 000	1.45	1.66	71.60	0.96
Eritrea	5 558 000	1.48	0.89	0.81	3.16
Ethiopia	84 838 000	1.39	4.86	3.64	4.74
Gambia	1 628 000	0.00	0.12	0.00	0.00
Niger	15 303 000	5.23	2.34	4.67	1.59

- (a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.  
Show your working.

$$\text{number of cases} = \frac{1.39}{100\,000} \times 84\,838\,000$$

$$\approx 1179$$

[2]

- (ii) Use the data for Chad, Eritrea and Ethiopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

- Different countries have different population
- Showing data as number of cases of measles per 100 000 people gives a proportion or fraction of the country that is infected with measles.
- Giving total number of cases is misleading due to different population sizes.
- For instance, Ethiopia has 1179 cases while Eritrea only had 82 cases. However, a larger proportion of Eritrea (1.48 per 100 000 people) is infected as compared to Ethiopia (1.39 per 100 000 people). (Ethiopia has larger population)

9700/22/M/J/16

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

### Q3 Mark scheme

- (a)(i) 1179 ;  
one mark if not to the whole person e.g. 1179.24 / 1179.2 or if calculation correct but answer incorrect  
e.g.  $1.39 \times 848.38$  or  $1.39 \times (84\,838\,000/100\,000)$  or if no calculation to check but answer given as 1180 [2]
- (a)(ii) 1 provides information about / AW, proportion / percentage, (of population) affected / AW ;  
2 to, make (valid) comparisons / compare ; between countries / in one country over time  
3 provides information about severity of disease ; AW  
4 population size, taken into account / different for different countries / changes over time in a country ; do not need 'size' if 'use of 'population' is in correct context  
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7 use of data to support ; only two of Chad, Eritrea or Ethiopia where comparisons between countries stated I ref. to other countries (2009) actual cases and standardised cases  
comparison (2009) to support mp 5 population size and actual cases  
stated values of similar number of cases per 100 000 and populations of different sizes  
countries compared, number of cases per 100 000 for any stated year, with comment about severity  
number of cases per 100 000 for one country over time, with comment about severity / spreading / dying out / control / AW [max 3]

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

- The percentage vaccinated represents children under one year of age who have been given at least one dose of the vaccine against measles in the given year.
- The data are for the six African countries shown in Table 3.1.

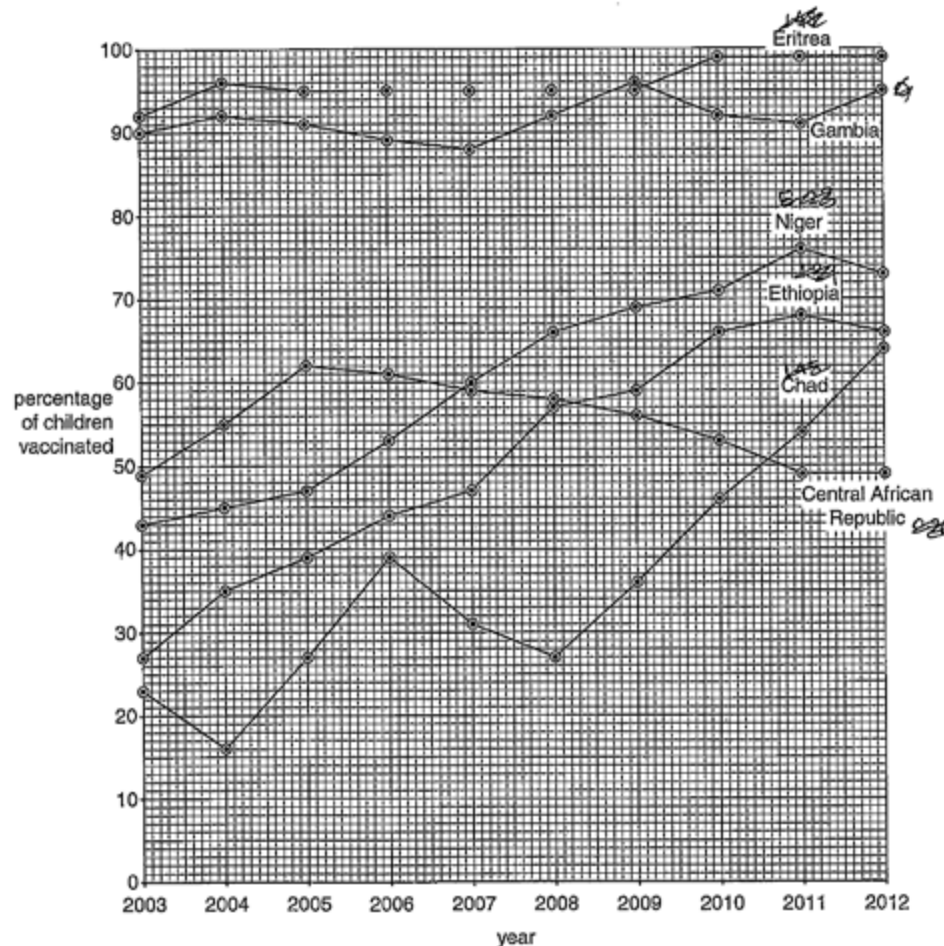


Fig. 3.1

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

Q3	Mark scheme
(b)	<p>can give values of percentage vaccinated to describe 'increasing / decreasing' percentage vaccination</p> <p><i>support</i></p> <p>1 Gambia high percentage vaccinated (throughout) and low number of cases ;</p> <p><b>A</b> Eritrea</p> <p>2 data to support ; e.g. a percentage vaccination for a year and number of cases (same, or following, year after vaccination) or a range given for percentage vaccinations over the whole, or stated, number of years or a compilation of the two</p> <p><i>partial / weak, support</i></p> <p>3 Central African Republic decreasing vaccination and number of cases in 2011, higher / 15.31 ;</p> <p>4 Chad (from 2008) increasing percentage vaccination and, low / stated, number of cases, 2009 / 2010 / 2012 ; 1.45 1.66 0.96</p> <p><i>do not support</i></p> <p>5 Niger / Ethiopia / Chad, (generally) increasing percentage vaccinated and number of cases, fluctuates / increase and decrease (ora) / AW ;</p> <p><b>A</b> stated correct data to show increase and decrease</p> <p><b>A</b> for Chad if mp 4 given and ref. to increase / 71.6 in 2011</p> <p>6 (generally) increasing percentage vaccinated and number of cases, increases / goes from 2.34–4.67, in 2011 in Niger or increases / goes from 1.39–4.86, in 2010 in Ethiopia or increases / goes from 1.66–71.6, in 2011 in Chad <b>A</b> 1.45–1.66 in 2010 ;</p> <p>7 Central African Republic decreasing vaccination and low number of cases in, 2009 / 2010 / 2012 ;</p> <p>8 / 9 AVP ;; e.g.</p> <ul style="list-style-type: none"> <li>idea that most values for number of cases are low irrespective of vaccination percentage</li> <li>ref.to needs, high / 90%, vaccination to be effective <b>A</b> &lt; 80% / low, vaccination ineffective</li> <li>idea that generally Gambia / Eritrea, have higher percentage vaccinated and have lower number of cases than, (three of) Ethiopia, Chad, Central African Republic, Niger / the other countries</li> </ul>

(b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement and comment on the data that do not support this statement.

In Chad, after 2009, % of children vaccinated fell steadily from 56% to 49% by 2011 and stayed at this level until 2012.

In Chad, the number of measles cases per 100,000 increased from 1.45 to 1.66 (2009) to 71.60 (2011) to showing a atypical low of 0.96 at 2012. So as vaccination % fell incidence increased.

However, Central African Republic shows a steep increase in % of vaccinated children for 2009 to 2012 but shows a general decrease in incidence from 2009 to 2010 but shows a steep increase in 2011. This is incongruous, most probably because

the virus mutated forming a different strain in this country rendering this vaccine ineffective, or vaccine was ineffective to begin with and required a booster.

(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline two features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

Smallpox causative agent - variola virus - has only one strain with no adaptive antigenic shift or drift occurring, so not change in vaccine required.

Awareness of this disease was high in both rich and poor nations so supply of volunteers was always high in each region. Symptoms were also obvious and specific so tracing of infected and contact with uninfected was easier. [2]

(d) State precisely the type of immunity gained by receiving a measles vaccine.

Artificial Active Immunity [1]

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

Q3	Mark scheme
(b) cont.	<ul style="list-style-type: none"> <li>ref. to Chad / Central African Republic, in 2011 and, epidemics / inability to keep number of cases down / ineffectiveness of vaccination programme / ref. to 71.6 (Chad) or 15.31 (Central African Republic)</li> <li>Eritrea 2012 high vaccination but, increase in / 3.16, cases</li> <li>ref. to increasing percentage of vaccination in Niger and decrease in cases, 2009–2010 from 5.23 to 2.34 / 2011–2012 from 4.67–1.59 A 2009–2012 from 5.23 to 1.59 [max 4]</li> </ul>
(c)	<p>points refer to smallpox, look for points written as ora any two from</p> <ol style="list-style-type: none"> <li>high, percentage / proportion, immunised / vaccinated ; AW A mass vaccination</li> <li>no boosters required / one dose enough / immunity very long-lived; A idea of long-lasting effect of vaccine</li> <li>same, vaccine / antigens, used (throughout) ; treat as neutral ref. to, low mutation rate / stability, of smallpox virus</li> <li>heat stable / thermostable / freeze-dried / lyophilised, vaccine ; I frozen A no need to refrigerate / AW A idea of longer shelf-life</li> <li>ease of, administering vaccine / training people to give vaccine ;</li> <li>ring vaccination / described, e.g. contact tracing ;</li> <li>easy to identify infected people / AW, (to begin ring vaccination) ;</li> <li>lower percentage cover required for smallpox than measles / lower herd immunity required;</li> <li>AVP ; smallpox less infectious (so lower percentage cover required) idea of less, civil unrest / war / movement of populations (so easier to implement) suggestion that smallpox live vaccine (and measles not live) [max 2]</li> </ol>
(d)	active artificial / artificial active ; treat as neutral acquired [1]



- (e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

- 1 Cost of developing and researching the vaccines for the virus.
- 2 Cost of manufacturing and transporting the vaccines for the virus to the regions where vaccination is required.

[Total: 14]

- 4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

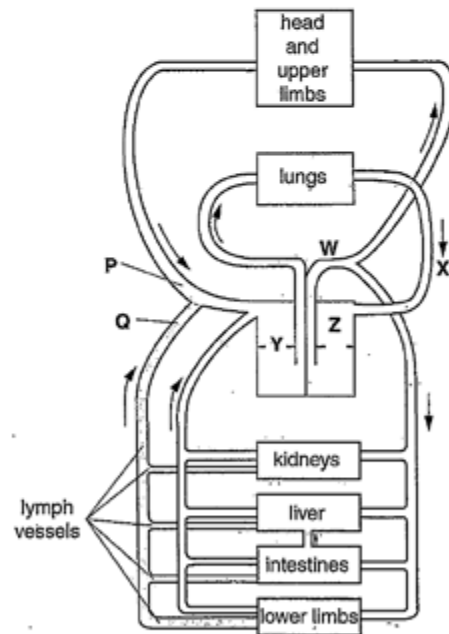


Fig. 4.1

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

### Q3 Mark scheme

(e)	can be from point of view of country programme or WHO programme cost
	1 preparing / manufacturing / purchasing, vaccine ; A cost to provide vaccine free to developing countries
	2 disposables / equipment to administer (vaccine) ; e.g. syringes / needles / (protective) gloves
	3 storage ; e.g. space, security
	4 refrigeration / maintaining cold chain ;
	5 transport (of, vaccine / health care workers) ;
	6 wages / training, of staff involved ; e.g. wages for, health care workers administering vaccine / staff involved in training health care workers
	7 record keeping / contact tracing ;
	8 advertising / informing / marketing / education ;
	9 research / development ;
	10 setting up vaccination / immunisation, camps (for remote / epidemic, areas) ;
	1 building, hospitals / clinics

[max 2]

- 3 Globally, measles is an important disease that mainly affects children. Many deaths from measles occur in children under five years of age.

Table 3.1 shows the population of six countries in Africa in 2009 and the number of cases of measles per 100 000 people for the four years 2009 to 2012.

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- (a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.

Show your working.

$$\frac{84\,838\,000}{100\,000} = 848.38$$

$$848.38 \times 1.39 = 1179.25$$

$$\approx 1179 \text{ cases}$$

[2]

- (ii) Use the data for Chad, Eritrea and Ethiopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

If actual number was shown, it would be difficult to plot a graph or understand the results. It may be difficult to record results among such large numbers of people e.g. in Ethiopia, population is 84 838 000 and results cannot be recorded easily. If there is large population, some people may not report their cases of measles which makes the data inaccurate. In Chad, population is 11 371 000 and in Eritrea, 5 558 000.

[3]

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

### Q3 Mark scheme

(a)(i)	1179 ; one mark if not to the whole person e.g. 1179.24 / 1179.2 or if calculation correct but answer incorrect e.g. $1.39 \times 848.38$ or $1.39 \times (84\,838\,000/100\,000)$ or if no calculation to check but answer given as 1180 [2]
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[max 3]

Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

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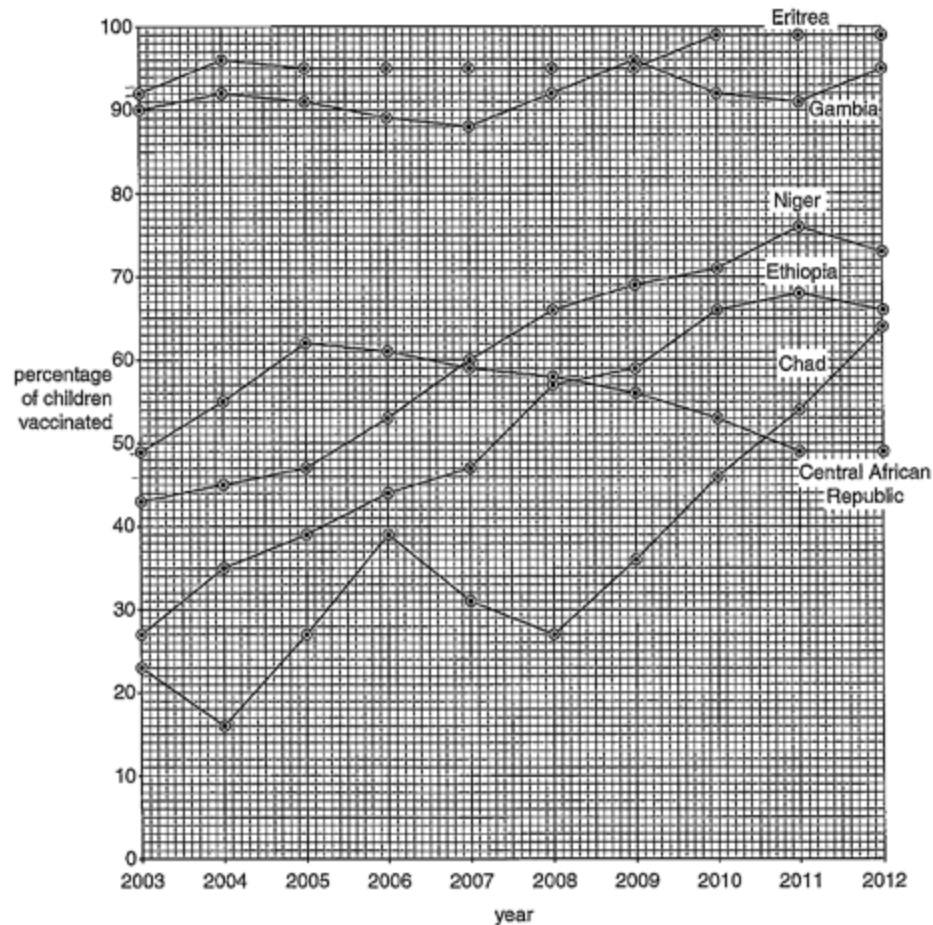


Fig. 3.1

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

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Q3	Mark scheme
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- (b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement and comment on the data that do not support this statement.

In <sup>Ethiopia</sup> ~~Eritrea~~, in 2010, <sup>66</sup>99% of children ~~was~~ vaccinated, but number of cases of measles was <sup>4.86</sup>very high (~~2160~~ people among 100,000) whereas in <sup>Chad</sup> ~~central African Republic~~ in 2010 46% <sup>children</sup> ~~people~~ were vaccinated but only <sup>1.66</sup>1.66 cases among 100,000 people are recorded. On the other hand, in Gambia, in 2003, 90% ~~we~~ were vaccinated, 2010 92% ~~and~~ in 2011, 91% and in 2012, 95% were vaccinated and there were no cases reported there except very few (0.12 among 100,000) in 2010 so here this statement is supported.

[4]

- (c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline two features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

→ The ~~smallpox~~ variola virus was stable and did not change its <sup>surface</sup> antigens, making vaccine production easier.

→ Vaccine produced was thermostable and could be kept in hot climates for long periods (such as in the tropics)

[2]

- (d) State precisely the type of immunity gained by receiving a measles vaccine.

Artificial active immunity

[1]

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

Q3	Mark scheme
(b) cont.	<ul style="list-style-type: none"> <li>ref. to Chad / Central African Republic, in 2011 and, epidemics / inability to keep number of cases down / ineffectiveness of vaccination programme I ref. to 71.6 (Chad) or 15.31 (Central African Republic)</li> <li>Eritrea 2012 high vaccination but, increase in / 3.16, cases</li> <li>ref. to increasing percentage of vaccination in Niger and decrease in cases, 2009–2010 from 5.23 to 2.34 / 2011–2012 from 4.67–1.59 A 2009–2012 from 5.23 to 1.59 [max 4]</li> </ul>
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(d)	active artificial / artificial active ; treat as neutral acquired [1]

- (e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

- 1 ..... cost of infrastructure, to get to poor areas where roads etc have not been built and cases of measles are high in number.
- 2 ..... cost of providing educational facilities to people in remote areas to educate them of the importance of getting vaccinated.

[Total: 14]

- 4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

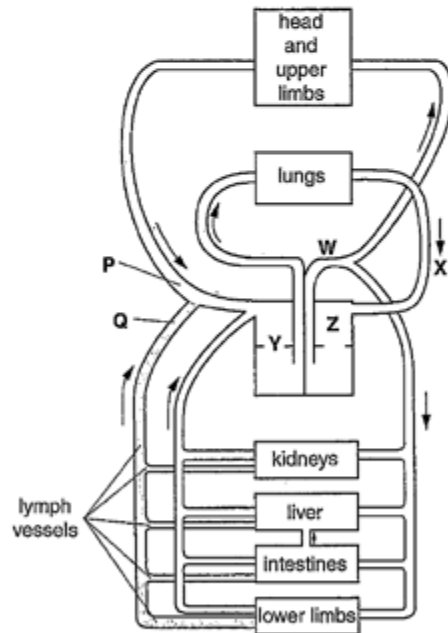


Fig. 4.1

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

Q3

Mark scheme

- (e) can be from point of view of country programme or WHO programme cost
- 1 preparing / manufacturing / purchasing, vaccine ; A cost to provide vaccine free to developing countries
  - 2 disposables / equipment to administer (vaccine) ; e.g. syringes / needles / (protective) gloves
  - 3 storage ; e.g. space, security
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  - 10 setting up vaccination / immunisation, camps (for remote / epidemic, areas) ;
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[max 2]

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- (a) (i) The actual number of cases of measles in Chad in 2009 was 165 and in Eritrea was 82.

Calculate the actual number of cases of measles in Ethiopia in 2009.  
Show your working.

$$\text{Chad: } \frac{165}{100,000} \times 11,371,000 = 1876.215 \quad \text{Eritrea} = \frac{82}{5,558,000} \times 5,558,000 = 82$$

$$\text{Ethiopia} = \frac{1.39}{100,000} \times 84,838,000 = 1179.2$$

- (ii) Use the data for Chad, Eritrea and Ethiopia to explain the advantages of showing the data in Table 3.1 as number of cases of measles per 100 000 people rather than the actual number of cases.

The number of population is too big if using actual numbers. This may cause confusion problems. It is easier to use cases per 100 000 for all of the country has over 1 million population.

It is simplified into two decimal. It is simple to use.

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

## Q3 Mark scheme

- (a)(i) 1179 ;  
one mark if not to the whole person e.g. 1179.24 / 1179.2 or if calculation correct but answer incorrect  
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Fig. 3.1 shows the percentage of children vaccinated against measles over a ten year period from 2003 to 2012.

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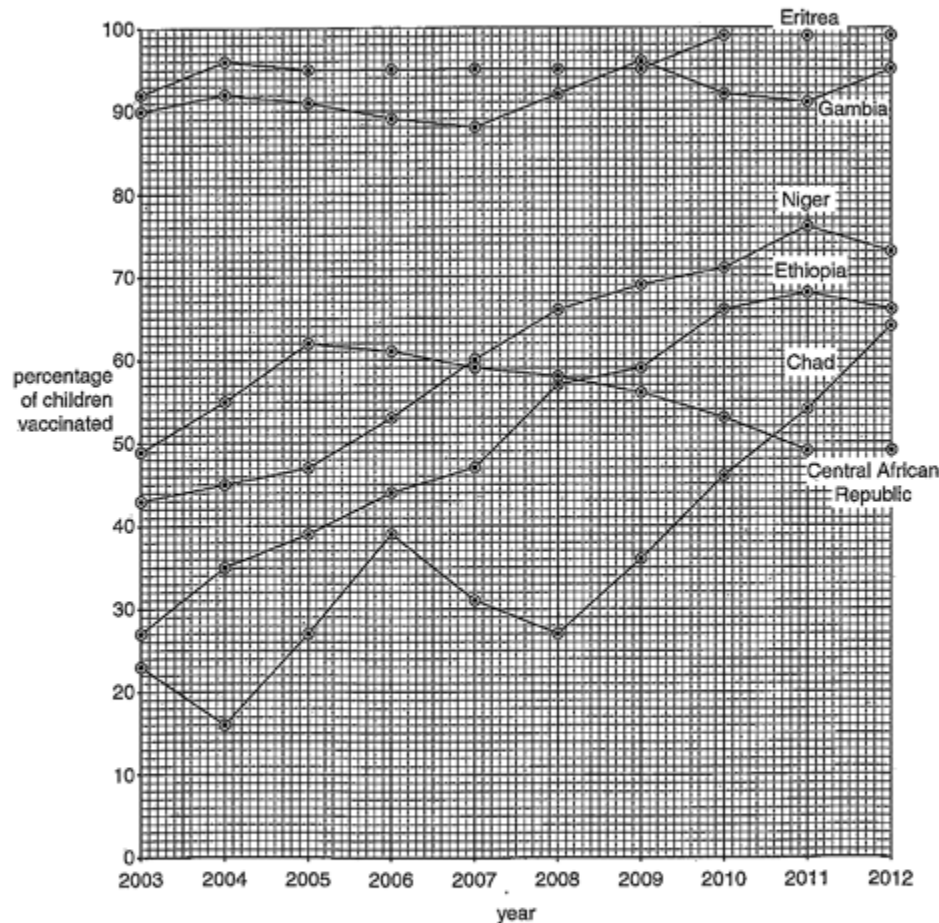


Fig. 3.1

Your  
Mark

3(a)(i)

3(a)(ii)

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### Q3 Mark scheme

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*support*
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**A** stated correct data to show increase and decrease  
**A** for Chad if mp 4 given and ref. to increase / 71.6 in 2011
  - (generally) increasing percentage vaccinated and number of cases, increases / goes from 2.34–4.67, in 2011 in Niger or increases / goes from 1.39–4.86, in 2010 in Ethiopia or increases / goes from 1.66–71.6, in 2011 in Chad **A** 1.45–1.66 in 2010 ;
  - Central African Republic decreasing vaccination and low number of cases in, 2009 / 2010 / 2012 ;
  - 8 / 9 AVP ; e.g.
    - idea that most values for number of cases are low irrespective of vaccination percentage
    - ref.to needs, high / 90%, vaccination to be effective  
**A** < 80% / low, vaccination ineffective
    - idea that generally Gambia / Eritrea, have higher percentage vaccinated and have lower number of cases than, (three of) Ethiopia, Chad, Central African Republic, Niger / the other countries



(b) Vaccination is known to protect populations against infectious diseases.

Some of the data in Table 3.1 (on page 4) and Fig. 3.1 (on page 6) support this statement.

Describe the data that support this statement and comment on the data that do not support this statement.

Country evidence that proves the statement is such as the country like Eritrea in 2011, which has 99 % of children vaccinated have 0.81 per 100 000 cases of measles. This suggests that when higher number of people vaccinated there should be less cases of measles.

Evidence that do not support the statement is Gambia having 0.00 per 100 000 cases of measles where only 54 % of children being vaccinated. This suggests that the evidence has an error because there's a chance the other 46 % are exposed to being having measles. [4]

(c) The successful eradication of smallpox involved an intensive global vaccination programme. It is hoped that the same can be achieved with measles.

Outline two features, apart from cost, of the smallpox eradication programme that may have made it easier to eradicate than measles.

1. Smallpox the DNA of smallpox is static as it does not change or <sup>turn</sup> mutant hence easy to produce large numbers of vaccines.

2. Better sanitation management.

[2]

(d) State precisely the type of immunity gained by receiving a measles vaccine.

A artificial active immunity. [1]

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

Q3	Mark scheme
(b) cont.	<ul style="list-style-type: none"> <li>ref. to Chad / Central African Republic, in 2011 and, epidemics / inability to keep number of cases down / ineffectiveness of vaccination programme / ref. to 71.6 (Chad) or 15.31 (Central African Republic)</li> <li>Eritrea 2012 high vaccination but, increase in / 3.16, cases</li> <li>ref. to increasing percentage of vaccination in Niger and decrease in cases, 2009–2010 from 5.23 to 2.34 / 2011–2012 from 4.67–1.59 A 2009–2012 from 5.23 to 1.59 [max 4]</li> </ul>
(c)	<p>points refer to smallpox, look for points written as or any two from</p> <ol style="list-style-type: none"> <li>high, percentage / proportion, immunised / vaccinated ; AW A mass vaccination</li> <li>no boosters required / one dose enough / immunity very long-lived; A idea of long-lasting effect of vaccine</li> <li>same, vaccine / antigens, used (throughout) ; treat as neutral ref. to, low mutation rate / stability, of smallpox virus</li> <li>heat stable / thermostable / freeze-dried / lyophilised, vaccine ; I frozen A no need to refrigerate / AW A idea of longer shelf-life</li> <li>ease of, administering vaccine / training people to give vaccine ;</li> <li>ring vaccination / described, e.g. contact tracing ;</li> <li>easy to identify infected people / AW, (to begin ring vaccination) ;</li> <li>lower percentage cover required for smallpox than measles / lower herd immunity required;</li> <li>AVP ; smallpox less infectious (so lower percentage cover required) idea of less, civil unrest / war / movement of populations (so easier to implement) suggestion that smallpox live vaccine (and measles not live) [max 2]</li> </ol>
(d)	active artificial / artificial active ; treat as neutral acquired [1]

- (e) Planning the prevention and control of measles using a vaccination programme means that financial costs must be considered.

State two examples of these costs.

1 The cost of incubators to grow the bacteria are expensive

2 The cost for making enzyme is expensive

[2]

[Total: 14]

- 4 Fig. 4.1 is a simplified diagram of the circulatory system of a mammal. Some of the lymph system is also shown.

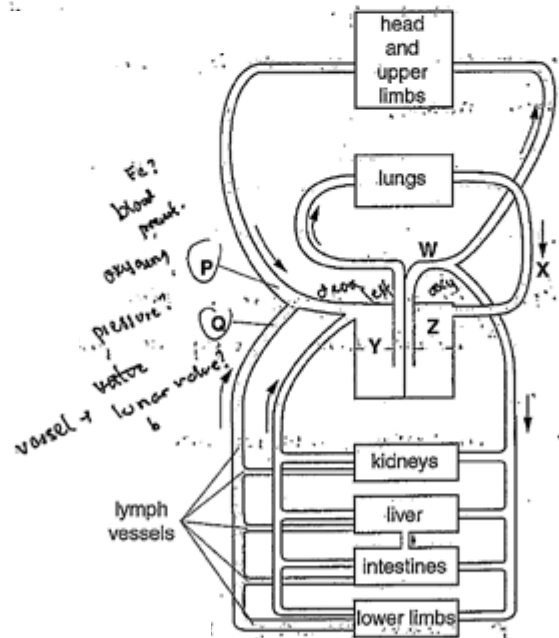


Fig. 4.1

Your  
Mark

3(a)(i)

3(a)(ii)

3(b)

3(c)

3(d)

3(e)

### Q3 Mark scheme

- (e) can be from point of view of country programme or WHO programme cost
- 1 preparing / manufacturing / purchasing, vaccine ; A cost to provide vaccine free to developing countries
  - 2 disposables / equipment to administer (vaccine) ; e.g. syringes / needles / (protective) gloves
  - 3 storage ; e.g. space, security
  - 4 refrigeration / maintaining cold chain ;
  - 5 transport (of, vaccine / health care workers) ;
  - 6 wages / training, of staff involved ; e.g. wages for, health care workers administering vaccine / staff involved in training health care workers
  - 7 record keeping / contact tracing ;
  - 8 advertising / informing / marketing / education ;
  - 9 research / development ;
  - 10 setting up vaccination / immunisation, camps (for remote / epidemic, areas) ;
  - 1 building, hospitals / clinics

[max 2]

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