Aerospace Systems 2019 v1.1

IA2 sample marking scheme

October 2018

Examination (25%)

This sample has been compiled by the QCAA to model one possible approach to allocating marks in an examination. It matches the examination mark allocations as specified in the syllabus (~60% simple familiar, ~20% complex familiar and ~20% complex unfamiliar) and ensures that a balance of the objectives are assessed.

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace operational systems
2. symbolise and explain ideas, solutions and relationships in relation to aerospace operational systems
3. analyse problems and information in relation to aerospace operational systems
5. synthesise information and ideas to propose possible aerospace operational systems solutions
7. evaluate and refine ideas and solutions to make justified recommendations.

Note: Objectives 4, 6 and 8 are not assessed in this instrument.

Instrument-specific marking guide (ISMG)

Criterion: Aerospace Systems knowledge and problem-solving

Assessment objectives

1. recognise and describe problems, aerospace technology knowledge, concepts and principles, and systems thinking habits and systems thinking strategies in relation to aerospace operational systems
2. symbolise and explain ideas, solutions and relationships in relation to aerospace operational systems
3. analyse problems and information in relation to aerospace operational systems
5. synthesise information and ideas to propose possible aerospace operational systems solutions
7. evaluate and refine ideas and solutions to make justified recommendations.

The student work has the following characteristics:	Cut-off	Marks
• across the full range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; adept symbolisation and discerning explanation of ideas, solutions and relationships; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions; critical evaluation and discerning refinement of ideas and solutions to make astutely justified recommendations.	> 96%	25
	> 93%	24
• in a comprehensive range of simple familiar, complex familiar and complex unfamiliar situations – accurate and discriminating recognition and discerning description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; adept symbolisation and discerning explanation of ideas, solutions and relationships; insightful and accurate analysis of problems and information; coherent and logical synthesis of information and ideas to propose possible solutions; critical evaluation and discerning refinement of ideas and solutions to make astutely justified recommendations.	> 89%	23
	> 86%	22
• in a comprehensive range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; methodical symbolisation and effective explanation of ideas, solutions and relationships; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions; reasoned evaluation and effective refinement of ideas and solutions to make considered recommendations.	> 82%	21
	> 78%	20

The student work has the following characteristics:	Cut-off	Marks
• in a range of simple familiar situations, and in complex familiar and complex unfamiliar situations – accurate recognition and effective description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; methodical symbolisation and effective explanation of ideas and solutions; considered analysis of problems and information; logical synthesis of information and ideas to propose possible solutions; reasoned evaluation and effective refinement of ideas and solutions to make considered recommendations.	> 75%	19
	> 71%	18
• in a range of simple familiar situations and in complex familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 68%	17
	> 64%	16
• in a range of simple familiar situations and in some complex familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; competent symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 60%	15
	> 57%	14
• in simple familiar situations – appropriate recognition and description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; variable symbolisation and appropriate explanation of ideas and solutions; appropriate analysis of problems and information; simple synthesis of information and ideas to propose possible solutions; feasible evaluation and adequate refinement of ideas and solutions to make fundamental recommendations.	> 53%	13
	> 50%	12
• in simple familiar situations – variable recognition and superficial description of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; variable symbolisation and superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose possible solutions; superficial evaluation and adequate refinement of ideas and solutions to make elementary recommendations.	> 46%	11
	> 42%	10
• in some simple familiar situations – variable recognition and superficial description of aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; superficial explanation of ideas and solutions; superficial analysis of problems and information; rudimentary synthesis of information and ideas to propose partial possible solutions; superficial evaluation of ideas and solutions to make elementary recommendations.	> 37%	9
	> 33%	8

The student work has the following characteristics:	Cut-off	Marks
• in a limited range of simple familiar situations – variable recognition and superficial description of aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; superficial explanation of ideas and solutions; superficial analysis of aspects of problems and information; unclear combination of information and ideas; superficial evaluation of ideas and solutions.	> 28%	7
	> 24%	6
• disjointed recognition and statements about aspects of aerospace operational systems problems, knowledge, concepts and principles, and systems thinking habits and systems thinking strategies; identification of a change about ideas, solutions and information; unclear combination of information and ideas.	> 19%	5
	> 14%	4
• statements about aspects of aerospace operational systems problems, knowledge, concepts and principles; statements about ideas, solutions and information; isolated and unclear combination of information and ideas.	> 10%	3
	> 5%	2
• isolated and unclear statements about aspects of aerospace operational systems problems, knowledge, concepts and principles.	> 0%	1
• does not satisfy any of the descriptors above.		0

Task

See the sample assessment instrument for IA2: Examination (25%) (available on the QCAA Portal).

Sample marking scheme

Criterion	Marks allocated	Result
Aerospace Systems knowledge and problem-solving Assessment objectives 1, 2, 3, 5 and 7	25	25
Total	**25**	25

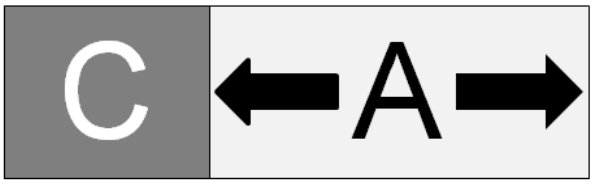
The annotations are written descriptions of the expected response for each question and are related to the assessment objectives.

Marking scheme symbols and abbreviations

The following marking scheme symbols and abbreviations should be used where possible.

Symbol or abbreviation	Meaning
✓	The preceding section of the expected response is worth one mark.
/	Separates acceptable alternative wordings in the expected response.
()	Terms in brackets are not necessary in the response for the mark to be awarded.
underlined text	Underlined text must be included in the response for the mark to be awarded.
Accept converse.	Award the mark even if the answer is stated in its converse form, e.g. 'A comes before B' can be stated as 'B comes after A'.
Accept min–max.	Award the mark for any numerical answer that falls within the specified range, e.g. 'Accept 1.5–1.9' means that any answer between 1.5 and 1.9 should be considered correct. This is used in items that involve a multi-step calculation where differences in rounding in the intermediate steps could result in slight differences in the final answer.
Allow for FT error.	Means 'allow for follow-through error'. Initial errors should only be penalised once. Marks should be awarded for subsequent steps that are correct.
Allow FT error for transcription only.	Follow-through error is only allowed if the student has written down information incorrectly but processed it correctly.
AND	Separates two parts of the response that are both required for the mark to be awarded.
Correct d.p. required.	The answer must be stated to the number of decimal places indicated in the item for the mark to be awarded.
Correct s.f. required.	The answer must be stated to the correct number of significant figures indicated in the item for the mark to be awarded.
Max. # marks	The maximum number of marks that can be awarded for the item is indicated by #. This is used where the number of possible correct answers is larger than the mark value of the item.
OR	Separates acceptable alternative wordings
OWTTE	Means 'or words to that effect'. This is used in questions where students are unlikely to use the exact wording given in the expected response. If the student's response has the same meaning as the expected response, then the mark should be awarded.
Working not required.	Evidence of working, reasoning or calculations is not required for the mark to be awarded.

Note: ✓ = 1 mark	**Marking scheme**
Section 1 — multiple-choice, single-word and sentence response items	
Recognise and describe aerospace concepts and principles in relation to operational accident and incident investigation processes	**Question 1 (1 mark)** **D** improve safety and build public confidence in aviation transportation. ✓
Recognise and describe aerospace concepts and principles in relation to operational accident and incident investigation processes	**Question 2 (1 mark)** **C** to ensure the safety of the travelling public. ✓
Recognise and describe aerospace concepts and principles in relation to international and national operational safety systems	**Question 3 (1 mark)** **A** United Nations. ✓
Recognise and describe aerospace concepts and principles in relation to international and national operational safety systems	**Question 4 (1 mark)** **A** civil aircraft. ✓
Recognise and describe aerospace concepts and principles in relation to airspace management operational systems	**Question 5 (1 mark)** **B** Airservices Australia. ✓

Recognise and describe aerospace technology knowledge in relation to airspace management operational systems	**Question 6 (1 mark)** VHF OR very high frequency ✓
Recognise and describe aerospace technology knowledge in relation to airspace management operational systems	**Question 7 (2 marks)** VFR — Visual Flight Rules ✓ IFR — Instrument Flight Rules ✓
Symbolise and explain relationships in relation to airport and airline operation systems	**Question 8 (2 marks)**  ✓✓
Recognise and describe aerospace concepts and principles in relation to safety management systems	**Question 9 (1 mark)** human ✓
Recognise and describe aerospace concepts and principles in relation to safety management systems	**Question 10 (4 marks)** **S** — software ✓ **H** — hardware ✓ **E** — environment ✓ **L** — liveware ✓
Recognise and describe aerospace concepts and principles in relation to airspace management	**Question 11 (2 marks)** Scheduled maintenance occurs at regular intervals. It is usually performed after a prescribed number of flight hours and number of take-offs and landings. ✓ On-occurrence maintenance occurs when an aircraft component failure is detected during routine operational checks and is rectified immediately outside of scheduled

systems	aircraft maintenance. ✓ OWTTE
Recognise and describe aerospace concepts and principles in relation to airspace management systems Award 3 marks for 6 correct responses.	**Question 12 (3 marks)** **I** — India **G** — Golf ✓ **N** — November **O** — Oscar ✓ **R** — Romeo **E** — Echo ✓
Recognise and describe aerospace concepts and principles in relation to safety management systems	**Question 13 (1 mark)** just safety culture ✓
Recognise and describe aerospace concepts and principles in relation to airspace management systems	**Question 14 (1 mark)** a region in which the same standard time is used ✓ OWTTE
Recognise and describe aerospace concepts and principles in relation to airspace management systems	**Question 15 (2 marks)** its offset or difference ✓ (OWTTE) from the Coordinated Universal Time OR UTC ✓
Recognise and describe concepts and principles in relation to airport and airline operation systems	**Question 16 (6 marks)** Location ✓ Runway design ✓ Environmental ✓ Terminal design ✓ Accessibility ✓ Security ✓ OWTTE

Section 2 — Short-paragraph and calculation items

Recognise and describe aerospace concepts and principles in relation to airspace management systems

Explain relationships

Question 17 (3 marks)

The phonetic alphabet is used to make sure that communications between aircraft and air traffic control (ATC) are completely clear and that there is no risk of misinterpretation of information. ✓ OWTTE The use of the phonetic alphabet enables communication between pilots and air traffic controllers of different language backgrounds and with different and unfamiliar accents to be more easily understood. This is critical in aviation as aircraft report identity, location and situation, especially during distress circumstances. ✓ ✓ OWTTE

2 marks for discerning explanation of relationships concerning the use of the phonetic alphabet and aircraft radio communications.

Recognise and describe aircraft and airport operational systems

Analyse information

Synthesise information

1 mark for accurately recognising and describing the point-to-point and hub-and-spoke models.

2 marks for accurate analysis of information by comparing and contrasting the models.

Question 18 (5 marks)

Point-to-point network design models focus on the transport of passengers from a location of origin to a destination location. Passengers do not need to travel from or to another location to reach their destination. ✓ Often smaller carriers with smaller aircraft and lower overheads use this model, although the hub-and-spoke model is generally used, ✓ which disadvantages smaller airlines using smaller aircraft. ✓ OWTTE

The hub-and-spoke network design model requires passengers to transfer from a location of origin to a hub location where interconnecting flights transfer passengers on to their destination location. Passengers do not fly directly from their location of origin to their destination location. This model requires that interconnecting flights are timed to provide passengers with minimal waiting times. ✓ Flight delays can result in passengers not meeting connecting flights and wait times being experienced, so this model is less convenient than the point-to-point model. However, this model is more cost effective for larger airlines than the point-to-point model as payloads can be optimised and costs reduced to increase profit margins. ✓ OWTTE

2 marks for coherent and logical synthesis of information to discuss the impacts of the models on passengers and airlines.

Recognise and describe aircraft and airport operational systems

Analyse information

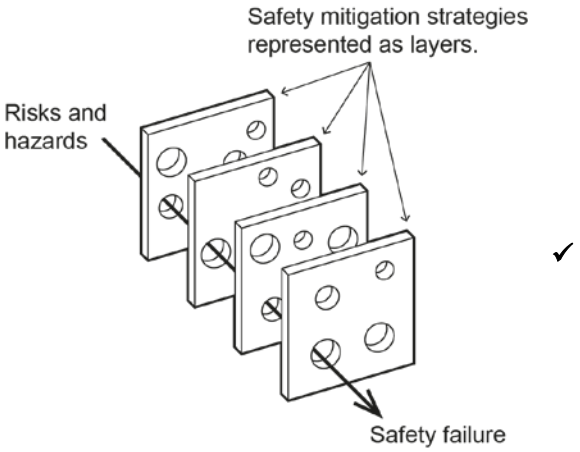
Synthesise information

Evaluate information

2 marks for accurately

Question 19 (8 marks)

Airport terminals that incorporate retail outlets provide passengers with opportunities to purchase goods prior to and after their travel. In addition, airport designers are aware that passengers often are required to wait for many hours between connecting flights. ✓ This is particularly the case for passengers connecting with international flights. ✓ Therefore, airports that include environments where passengers can shop or rest in pleasant, more spacious and comfortable surroundings, such as Figure 2, are effective in encouraging passengers to stay in the airport precinct rather than leaving. ✓ This keeps money in the airport's retail precinct and encourages more corporate involvement in airports. ✓ The more money the retail outlets make, the more rent can be charged by the airport corporation. ✓ For passengers, the result is that they experience a relaxing stay at the airport in a peaceful setting, ✓ or perhaps are entertained by various activities that allow their wait time to pass by more enjoyably. ✓ The airport corporation and retail outlets experience an

recognising and describing factors that create airport revenue opportunities. 2 marks for insightful and accurate analysis of the factors that promote airport revenue.	increased revenue stream because customers spend more time and money at the airport. ✓ OWTTE 1 mark for critical evaluation of information contained in the stimulus using identified criteria. 3 marks for logical and coherent synthesis of information to determine the relationships between factors that encourage customers to stay and spend time and money at the airport and the positive revenue opportunities created for corporate stakeholders.
Recognise and describe aircraft and airport safety management systems Symbolise and explain relationships in aircraft and airport safety management systems 1 mark for accurate and discriminating recognition and discerning description of the Swiss cheese model. 2 marks for adeptly symbolising the model to support a discerning explanation of the Swiss cheese model. 1 mark for accurate and discriminating recognition and discerning description of active failures. 1 mark for accurate and discriminating recognition and discerning description of latent conditions.	**Question 20 (5 marks)** The Swiss cheese model is used to analyse and manage risks to safety in aviation. The model likens slices of Swiss cheese to the layers of a safety system used to mitigate risk. ✓ A breakdown at one level is mitigated by subsequent layers of the safety system. However, if the holes (possible breaches) in these incorporated systems (cheese slices) align, a series of events can cause a safety failure to occur. ✓ OWTTE  ✓ Failures occur at two levels. Active failures include any unsafe acts that can be linked directly with an unsafe situation or accident. ✓ Latent conditions are those factors that have contributed to the accident but may have been dormant for a period of time. Such conditions may include a change to maintenance procedures which over time leads to a safety failure, or a cost saving strategy that reduces pilot or flight crew safety training. ✓ OWTTE

Recognise and describe aerospace technology knowledge, concepts and principles, and systems thinking strategies in relation to airspace management systems

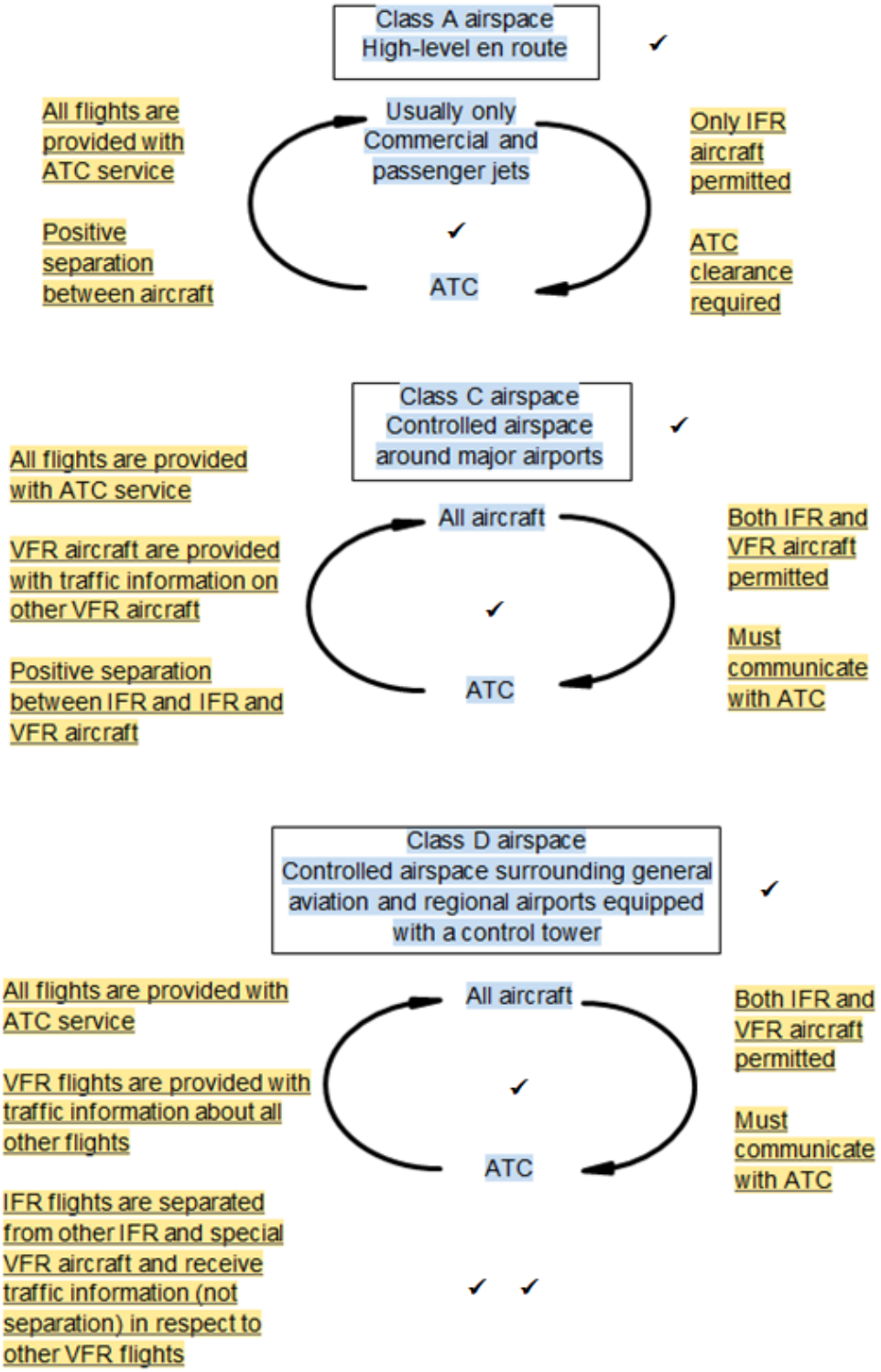
Symbolise and explain relationships in relation to airspace management systems

3 marks for accurate and discriminating recognition of the classes of airspace and showing good judgment in the use of systems thinking strategies to describe airspace management systems.

3 marks for adept symbolisation and discerning explanation of the relationships between ATC, IFR, VFR and aircraft separation standards.

2 marks for coherent and logical synthesis of information about system relationships.

Question 21 (8 marks)



Recognise and describe aerospace technology knowledge, concepts and principles

Evaluate and refine ideas and solutions

3 marks for accurate recognition and discerning description of CASA's administrative roles. OWTTE

3 marks for critical evaluation of CASA's administrative roles in the safe operation of aircraft. OWTTE

Question 22 (6 marks)

CASA licenses pilots and engineers, registers aircraft, oversees aviation safety and promotes safety awareness across the industry. ✓ CASA is responsible for ensuring that Australian airspace is administered and used safely. ✓ To be effective in this role requires that CASA works closely with other government agencies such as Airservices Australia, ATSB and the Department of Defence. These agencies advise CASA about safety issues they have found through activities such as safety investigations. CASA has a legislated responsibility to act on the information provided in a way that promotes collaboration through consultation and communication with the wider aviation community to support a positive and just safety culture. ✓ To be effective as a safety authority, CASA enters into agreements with other countries regarding such areas as airworthiness certification, aircraft maintenance certification systems and mutual recognition of air operator certification. ✓ Additionally, CASA has a number of arrangements with other countries, including Hong Kong, China, South Korea and New Zealand, to ensure that Australian aircraft operate safely and compliantly overseas ✓ and that overseas aircraft operate safely and compliantly in Australian airspace to maintain high safety standards and the confidence of the travelling public. ✓ OWTTE

Recognise and describe aerospace technology knowledge, concepts and principles
Analyse information
Synthesise information

For each part of the question a–f:
1 mark for accurate recognition and considered analysis of information to logically synthesise correct solutions.

Question 23 (6 marks)

a) $\text{PLF} = \frac{\text{seats filled}}{\text{seat available}}$

$= \frac{6 + 12 + 131}{8 + 14 + 148}$

$= \frac{149}{170} = 0.876 \approx 88\%$ ✓

b)

$\text{RPK} = \text{pax} \times \text{flight distance}$

$= 149 \times 2155 = 321\ 095$ ✓

c)

$\text{PY} = \frac{\text{pax revenue}}{\text{Revenue pax kilometers}}$

$= \frac{(6 \times 1200) + (12 \times 875) + (131 \times 230)}{321\ 095}$

$= \frac{7200 + 10\ 500 + 30\ 130}{321\ 095}$

$= 0.148\ 95 \approx 0.15$

$\therefore \text{PY} = 15 \text{ cents per pax per km}$ ✓

d)

$\text{ASK} = \text{available seats} \times \text{flight distance}$

$= (8 + 14 + 148) \times 2155$

$= 366\ 350$ ✓

e)

$$\text{speed} = \frac{\text{flight distance}}{\text{flight time}}$$

$$\text{flight time} = \frac{\text{flight distance}}{\text{speed}}$$

$$= \frac{2155}{765} = 2.8169 \approx 2.82 \text{ hours}$$

$$\text{total fuel consumption} = \text{fuel consumption per hour} \times \text{flight time}$$

$$= 2240 \times 2.82 = 6316.8 \approx 6317 \text{ L} \quad ✓$$

f)

$$\text{total fuel cost} = 6317 \times 1.46 = 9222.82$$

$$\text{total flight costs} = 9222.82 + 22\,475$$

$$= \$31\,697.82$$

$$\text{total income from the flight} = 7200 + 10\,500 + 30\,130$$

$$= \$47\,830$$

$$\text{profit} = \text{income} - \text{costs}$$

$$= 47\,830 - 31\,697.82$$

$$= \$16\,132.18 \quad ✓$$

Analyse information
Synthesise information
Evaluate and refine ideas and solutions

2 marks for considered analysis of the data provided in Table 1.

2 marks for coherent and logical synthesis of the information provided through the data.

1 mark for critical evaluation to recommend the better performing airline.

Question 24 (5 marks)

The data in the table indicates that Airline 1 carries 719 175 more customers than Airline 2. Airline 2 has 192 954 seats unattended on all its flights, while Airline 1 has 556 105 seats unattended on all its flights. ✓ The cost for available kilometre (CASK) for Airline 2 is less than Airline 1 by 1 cent and the revenue available seat kilometre is more for Airline 1 than for Airline 2. ✓ OWTTE

It would seem that Airline 1 has made a decision to offer more flights than Airline 2 with the result that they carry 719 175 more customers. ✓ However, Airline 1's aircraft fly with a total of 363 151 more unattended seats than Airline 2 aircraft, which means that these aircraft fly with a lower RPK and at a higher cost per pax km and with lower revenue per pax km. ✓ Therefore the data indicates that Airline 2 is the better performing airline as the aircraft are flown closer to capacity with far fewer empty seats. ✓ OWTTE