This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2016 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.
Mark Scheme Notes

Marks are of the following three types:

M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B Mark for a correct result or statement independent of method marks.

When a part of a question has two or more “method” steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

The symbol \( \checkmark \) implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously “correct” answers or results obtained from incorrect working.

Note: B2 or A2 means that the candidate can earn 2 or 0. B2/1/0 means that the candidate can earn anything from 0 to 2.

The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking \( g \) equal to 9.8 or 9.81 instead of 10.

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The following abbreviations may be used in a mark scheme or used on the scripts:

AEF/OE  Any Equivalent Form (of answer is equally acceptable) / Or Equivalent

AG  Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)

CAO  Correct Answer Only (emphasising that no “follow through” from a previous error is allowed)

CWO  Correct Working Only – often written by a ‘fortuitous’ answer

ISW  Ignore Subsequent Working

SOI  Seen or implied

SR  Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

Penalties

MR −1  A penalty of MR −1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become “follow through √ ” marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy. An MR −2 penalty may be applied in particular cases if agreed at the coordination meeting.

PA −1  This is deducted from A or B marks in the case of premature approximation. The PA −1 penalty is usually discussed at the meeting.
### Question 1

#### (i)

\[ 3.5 = 10a \quad \rightarrow \quad a = 0.35 \text{ ms}^{-2} \]

- **B1**
- Allow \( a = 3.5 / 10 \)
- For applying Newton’s 2nd law to the particle

\[ 10\cos15 - F = 2 \times 0.35 \]

- **M1**

\[ F = 8.96 \text{ N} \]

- **AG**

#### Alternative to (i)

\[ s = \frac{1}{2} (0 + 3.5) \times 10 = 17.5 \text{ m} \]

- **B1**
- Distanced moved in 10 secs

\[ 10\cos15 \times 17.5 = F \times 17.5 + \frac{1}{2} (3.5)^2 \]

- **M1**

\[ F = 8.96 \text{ N} \]

- **AG**

#### (ii)

\[ R = 2g - 10\sin15 \]

- **M1**
- Resolving forces vertically

\[ \mu = \frac{8.96}{(2g - 10\sin15)} \]

- **M1**
- Using \( F = \mu R \)

\[ \mu = 0.515 \]

- **A1**

### Question 2

#### (i)

\[ v = 4t - 40t^{0.5} \]

- **M1**
- For differentiating \( s \) to find \( v \)

\[ a = 4 - 20t^{-0.5} \]

- **M1**
- For differentiating \( v \) to find \( a \)

\[ 4 - 20t^{-0.5} = 0 \]

- **DM1**
- For setting \( a = 0 \) and attempt to solve to find \( t \)

\[ t = 25 \text{ s} \]

- **A1**

#### (ii)

Substitute their \( t \) into \( s \) or \( v \)

- **M1**
- or Displacement = \( -6250 / 3 \)

Displacement = \( -2083.3 \text{ m} = -2080 \text{ 3sf} \)

**and** Velocity = \( -100 \text{ ms}^{-1} \)

- **A1**
3 (i) \[ X = 60\cos 25 + 50\cos 15 \]
\[ = 103 \text{ N} \]
M1 For resolving both forces in the direction of river

A1 \[ \text{Value of } X \text{ is } 102.7 \text{ N} \] [2]

(ii) \[ Y = 60\sin 25 - 50\sin 15 \approx 12.4 \]
B1 Component perpendicular to the direction of the river

\[ R^2 = X^2 + Y^2 \]
M1 For using Pythagoras or for using \( \arctan \) to find the resultant force or its direction

\[ \alpha = \arctan(Y/X) \]

Magnitude is 103 N
(or \( \alpha = 6.9^\circ \) with direction specified unambiguously)

A1 Magnitude is 103.4 N

\[ \alpha = 6.9^\circ \text{ with direction specified unambiguously} \]
(or Magnitude = 103 N)
B1 [4]

4 (i) PE loss = \( mg \times 100\sin 20 \)
B1 Using KE gain = PE loss

\[ \frac{1}{2}mv^2 - \frac{1}{2}m \times 5^2 = mg \times 100\sin 20 \]
M1 \[ v = 26.6 \text{ ms}^{-1} \]
A1 [3]

Alternative method for 4(i)

\[ a = g \sin 20 \quad [= 3.42] \]
B1 Using \( v^2 = u^2 + 2as \)

\[ v^2 = 5^2 + 2 \times a \times 100 \]
M1 \[ v = 26.6 \text{ ms}^{-1} \]
A1 [3]

(ii) KE =
\[ \pm(0.5m \times 441 - 0.5m \times 25) \quad [= \pm 208m] \]
M1 For using PE loss = WD against Friction + KE gain

\[ mg \times 100\sin 20 = 8500 + 208m \]
B1

Mass \( m = 63.4 \text{ kg} \)
A1 [3]
### Question 5

\[ F = \mu mg \cos 30 \]

\[ [10 + F - mgsin30 = 0] \quad \text{M1} \quad \text{Resolving up, first case} \]

\[ [75 - F - mgsin30 = 0] \quad \text{M1} \quad \text{Resolving up, second case} \]

\[ [85 = 2mgsin30] \quad \text{M1} \]

or

\[ [10 + \mu mg \cos 30 - mgsin30 = 0] \quad \text{M1} \]

\[ 75 - \mu mg \cos 30 - mgsin30 = 0 \]

Either attempt to solve for \( m \) or

Solve a pair of two 3 term simultaneous equations for either \( m \) or \( \mu \)

\[ m = 8.5 \text{ kg or } \mu = 0.442 \quad \text{A1} \]

\[ \mu = 0.442 \text{ or } m = 8.5 \text{ kg} \quad \text{B1} \]

### Question 6

(i) [Power = 400 \times 25]

\[ \text{Power} = 10000 \text{ W} \quad \text{A1} \quad \text{[2]} \]

Allow 10kW

(ii) Tension = 100 N

\[ \text{B1} \quad \text{[1]} \]

Considering the trailer

(iii) New driving force

\[ = \frac{25000}{20} = 1250 \text{ N} \quad \text{B1} \]

Driving force = \( P/v \) at the instant when \( v = 20 \)

\[ [DF - 300 - T - 300g \sin 4 = 3000a] \quad \text{M1} \]

or \[ [T - 100 - 500g \sin 4 = 500a] \quad \text{M1} \]

or \[ [DF - 400 - 3500g \sin 4 = 3500a] \quad \text{M1} \]

\[ a = -0.4547 \text{ may be seen} \quad \text{M1} \]

\[ T = 221 \text{ N} \quad \text{A1} \quad \text{[5]} \]

Allow \( T = 1550/7 \text{ N} \)
7  

(i) \( v = 3 \times 10 = 30 \text{ ms}^{-1} \)

\[ s = \frac{1}{2} (30 + 40) \times 30 \]  
or equivalent complete method  

Total distance = 1050 m  

B1  

Velocity after 10 seconds  

For determining distance travelled in first 40 seconds  

M1  

A1  

[3]

(ii) [Distance = 450 m  
Time taken = 450 / 15 = 30 s]

Total time of motion for car = 70 s

Motorcycle takes 50 s to travel 1500 m

\[ 1500 = \frac{1}{2} (30 + 50) \times V \]  
or  \[ 1500 = 30V + 0.5 \times 20V \]

\[ V = 37.5 \text{ ms}^{-1} \]

\[ 1500 = \frac{1}{2} (30 + 50) \times V \]  
or  \[ 1500 = 30V + 0.5 \times 20V \]

\[ V = 37.5 \text{ ms}^{-1} \]

\[ 20 \text{ s is split between 5 s accelerating and 15 s decelerating} \]

\[ a = 37.5 / 5 = 7.5 \text{ ms}^{-2} \]

M1  

A1  

[6]

For finding distance covered in deceleration stage and time taken for this stage  

May be implied by time for motorcycle = 50 s  

For setting up an equation for distance travelled by M/C (v–t graph or other) involving \( V \) or \( a \) and up to one other variable.  

(iii) Displacement-time graph  

B1  

Two of the three graph stages correct with correct curvature  

All three stages of the graph correct with correct curvature  

Correct graph, fully labelled  

t=10,40,70s = 150,1050, 1500  

B1  

[3]