Cambridge Assessment International Education

Interactive

Interactive Example Candidate Responses
Paper 2 (May/June 2016), Question 1
Cambridge International AS & A Level Physics 9702

Version 1.0

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Answer all the questions in the spaces provided.

1 (a) Define *acceleration*.

rate of change of velocity

.....[1]

(b) A man travels on a toboggan down a slope covered with snow from point A to point B and then to point C. The path is illustrated in Fig. 1.1.

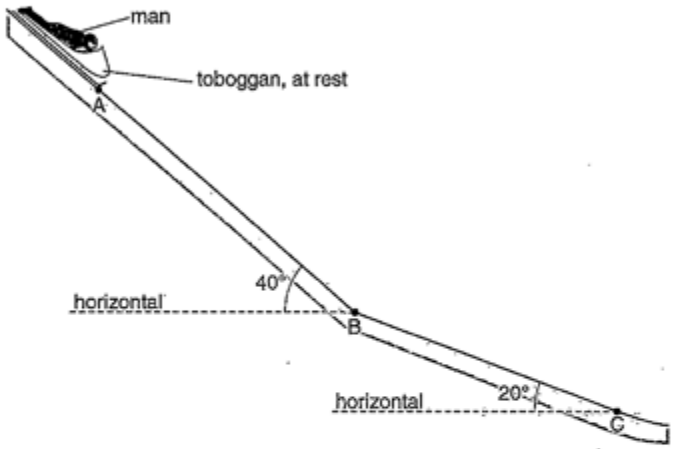

Fig. 1.1 (not to scale)

The slope AB makes an angle of 40° with the horizontal and the slope BC makes an angle of 20° with the horizontal. Friction is not negligible.

The man and toboggan have a combined mass of 95 kg.

The man starts from rest at A and has constant acceleration between A and B. The man takes 19 s to reach B. His speed is 36 m s^{-1} at B.

(i) Calculate the acceleration from A to B.

~~$v^2 = u^2 + 2as$~~
~~$36^2 = 0 + 2a(19)$~~
~~$a = 34$~~

$v = u + at$
$36 = a(19)$
$a = 1.9$

acceleration = ~~34~~ 1.9 m s^{-2} [2]

(ii) Show that the distance moved from A to B is 340 m.

$v^2 = u^2 + 2as$
$36^2 = 2(1.9)s$
$s = 342$
≈ 340 m

[1]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	

Q1	Mark scheme		
(a)	acceleration = change in velocity / time (taken) or rate of change of velocity B1		**[1]**
(b)(i)	$v = 0 + at$ or $v = at$ (a = 36 / 19 =) 1.9 (1.8947) m s^{-2}	C1 A1	**[2]**
(b)(ii)	$s = ½(u + v)t$ **or** $s = v^2/2a$ **or** $s = ½at^2$ = ½ x 36 x 19 = 36^2 / (2 x 1.89) = ½ x 1.89 x 19^2 = 340 m (342 m / 343 m / 341 m)	 M1	**[1]**
(b)(iii)	1. (ΔKE =) ½ x 95 x (36)^2 = 62 000 (61 560) J A1 2. (ΔPE =) 95 x 9.81 x 340 sin 40° or 95 x 9.81 x 218.5 = 200 000 J A1	C1 C1	[2] [2] **[4]**
(b)(iv)	work done (by frictional force) = ΔPE – ΔKE **or** work done = 200 000 – 62 000 (values from **1b(iii) 1.** and ***2.***) C1 (frictional force = 138 000 / 340 =) 410 (406) N [420 N if full figures used]	 A1	**[2]**
(b)(v)	$-ma = mg \sin 20° - f$ or $ma = -mg \sin 20° + f$ –95 x 3.0 = 95 x 3.36 – f f = 600 (604) N	C1	**[2]**

EXAMINER COMMENTS

MARK SCHEME

(iii) For the man and toboggan moving from A to B, calculate

1. the change in kinetic energy,

$\frac{1}{2}mv^2$

$= \frac{1}{2}(95)(36^2)$

$\approx 62\,000$

$= 61560$

change in kinetic energy = 62 000 J [2]

2. the change in potential energy.

~~change in KE~~ = change in PE

$= mgh$

$= 95 \times 9.81 \times 340$

$= 318727$

$\approx 319\,000$

change in potential energy = 319 000 J [2]

(iv) Use your answers in **(iii)** to determine the average frictional force that acts on the toboggan between A and B.

$318727 - 61560$

$= 257 \times 10^3$ J

$W = Fs$

$F = \frac{257 \times 10^3}{340}$

$= 750$

frictional force = 750 N [2]

(v) A parachute opens on the toboggan as it passes point B. There is a constant deceleration of 3.0 m s^{-2} from B to C.

Calculate the frictional force that produces this deceleration between B and C.

$F = ma$

$= 95 \times -3$

$= -285$

$F_p - F = ma$

$F_p = -285 + F$

$= -285 - 750$

$= -1035$ frictional force = 1035 N [2]

[Total: 12]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	

Q1	Mark scheme		
(a)	acceleration = change in velocity / time (taken) or rate of change of velocity B1		**[1]**
(b)(i)	$v = 0 + at$ or $v = at$ (a = 36 / 19 =) 1.9 (1.8947) m s^{-2}	C1 A1	**[2]**
(b)(ii)	$s = \frac{1}{2}(u + v)t$ **or** $s = v^2/2a$ **or** $s = \frac{1}{2}at^2$ = ½ x 36 x 19 = 36^2 / (2 x 1.89) = ½ x 1.89 x 19^2 = 340 m (342 m / 343 m / 341 m)	M1	**[1]**
(b)(iii)	1. (ΔKE =) ½ x 95 x (36)^2 = 62 000 (61 560) J A1 2. (ΔPE =) 95 x 9.81 x 340 sin 40° or 95 x 9.81 x 218.5 = 200 000 J A1	C1 C1	[2] [2] **[4]**
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(b)(v)	$-ma = mg$ sin 20° – f or $ma = -mg$ sin 20° + f –95 x 3.0 = 95 x 3.36 – f f = 600 (604) N	C1	**[2]**

EXAMINER COMMENTS

MARK SCHEME

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Answer **all** the questions in the spaces provided.

1 **(a)** Define *acceleration*.

final velocity − initial velocity / time.

[1]

(b) A man travels on a toboggan down a slope covered with snow from point A to point B and then to point C. The path is illustrated in Fig. 1.1.

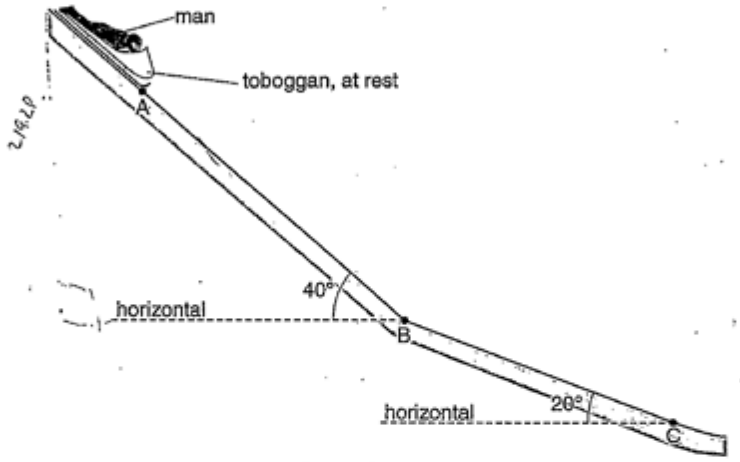

Fig. 1.1 (not to scale)

The slope AB makes an angle of 40° with the horizontal and the slope BC makes an angle of 20° with the horizontal. Friction is not negligible.

The man and toboggan have a combined mass of 95 kg.

The man starts from rest at A and has constant acceleration between A and B. The man takes 19 s to reach B. His speed is 36 m s^{-1} at B.

(i) Calculate the acceleration from A to B.

$a = \frac{36-0}{19}$

$a = \frac{36}{19}$

$a = 1.89$

acceleration = 1.89 m s^{-2} [2]

(ii) Show that the distance moved from A to B is 340 m.

~~s x t = d.~~ $s = ut + \frac{1}{2}at^2$.

$s = \frac{1}{2}at^2$ $s = \frac{1}{2} \times 1.89 \times (19)^2$

$s = 341.145$ m.

[1]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	

Q1	Mark scheme		
(a)	acceleration = change in velocity / time (taken) or rate of change of velocity B1		**[1]**
(b)(i)	$v = 0 + at$ or $v = at$ ($a = 36 / 19 =$) 1.9 (1.8947) m s^{-2}	C1 A1	**[2]**
(b)(ii)	$s = ½(u + v)t$ **or** $s = v^2 / 2a$ **or** $s = ½at^2$ $= ½ \times 36 \times 19 = 36^2 / (2 \times 1.89) = ½ \times 1.89 \times 19^2$ = 340 m (342 m / 343 m / 341 m)	 M1	**[1]**
(b)(iii)	1. ($\Delta KE =$) ½ x 95 x $(36)^2$ = 62 000 (61 560) J A1 2. ($\Delta PE =$) 95 x 9.81 x 340 sin 40° or 95 x 9.81 x 218.5 = 200 000 J A1	C1 C1 [2]	[2] **[4]**
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(b)(v)	$-ma = mg \sin 20° - f$ or $ma = -mg \sin 20° + f$ $-95 \times 3.0 = 95 \times 3.36 - f$ f = 600 (604) N	C1	**[2]**

EXAMINER COMMENTS

MARK SCHEME

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(iii) For the man and toboggan moving from A to B, calculate

1. the change in kinetic energy,

$E_K = \frac{1}{2}mv^2$

$E_K = \frac{1}{2} \times 95 \times 17.955$

$E_K = 852.86$ J

$v = \frac{d}{t}$ $v = \frac{341.145}{19}$ $v = 17.955$

change in kinetic energy = 852.86. J [2]

2. the change in potential energy.

$E_P = mgh$.

$E_P = 95 \times 9.81 \times 340 \sin 40$.

$= 204274$

change in potential energy = 204274 J [2]

(iv) Use your answers in (iii) to determine the average frictional force that acts on the toboggan between A and B.

$E_P - E_K$ = Friction Force.

$204274 - 852.86$.

203421.79

2.03×10^5

frictional force = 2.03×10^5. N [2]

(v) A parachute opens on the toboggan as it passes point B. There is a constant deceleration of 3.0 m s^{-2} from B to C.

Calculate the frictional force that produces this deceleration between B and C.

$F = ma$ $F = 95 \times 3$

$F = 285$ N.

frictional force = 285. N [2]

[Total: 12]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	

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EXAMINER COMMENTS

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Answer **all** the questions in the spaces provided.

1 **(a)** Define *acceleration*.

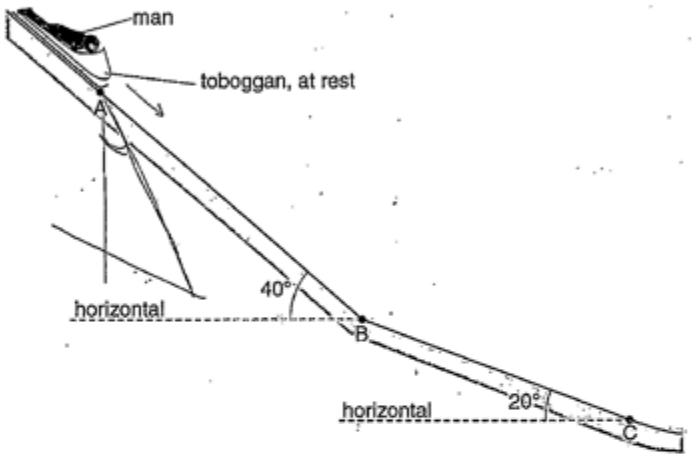
acceleration = change in velocity / time taken

change in speed

time taken

[1]

(b) A man travels on a toboggan down a slope covered with snow from point A to point B and then to point C. The path is illustrated in Fig. 1.1.



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(i) Calculate the acceleration from A to B.

$a = \frac{36}{19} \rightarrow 1.89$

acceleration = 1.89 m s^{-2} [2]

(ii) Show that the distance moved from A to B is 340 m.

$s = ut + \frac{1}{2}at^2 \quad s = 0 + \frac{1}{2} \times 1.89 \times 19^2$

$= 341.775\,\text{m} \simeq 340\,\text{m}$

[1]

Select page

HIGH | MIDDLE | LOW

	Your Mark
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EXAMINER COMMENTS

MARK SCHEME

(iii) For the man and toboggan moving from A to B, calculate

1. the change in kinetic energy,

$KE = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 95 \times 36$

$= 1710$

change in kinetic energy = 1710 J [2]

2. the change in potential energy.

$GPE = mgh$

$= 95 \times 9.81 \times h$

$= 95 \times 9.81 \times 219.8283$

$= 95 \times 9.81 \times$

$\sin 40° = \frac{0}{341.145} \therefore 0 = 341.145 \sin 40° = 219.283$

$1710 = 95 \times 9.81 \times h$

$h = 1.83$

$GPE = 95 \times 9.81 \times 1.83 = 1705.47$

change in potential energy = 1705 J [2]

(iv) Use your answers in (iii) to determine the average frictional force that acts on the toboggan between A and B.

$F = ma$

$W = mg$

$= 95 \times 9.81 \rightarrow 931.95$

frictional force = ... N [2]

(v) A parachute opens on the toboggan as it passes point B. There is a constant deceleration of $3.0\,m\,s^{-2}$ from B to C.

Calculate the frictional force that produces this deceleration between B and C.

$W - F = ma$

$W - F = 95 \times 3.0$

931.9

$932 - F = 285$

$F = 1217$

$W = mg$

$= 95 \times 9.81 \rightarrow 931.95$

frictional force = 1217 N [2]

[Total: 12]

	Your Mark
1(a)	
1(b)(i)	
1(b)(ii)	
1(b)(iii)	
1(b)(iv)	
1(b)(v)	

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EXAMINER COMMENTS

MARK SCHEME

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