Formative Student Answers Instructions

created 2019/12/08, updated 2020/03/17

For each topic we have a set of questions as a formative assessment. You can find all the Word documents (pdf) in the shared folder "IB Physics students > Formative" or in ManageBac. Check which questions you are assigned to: Class of 2020, Class of 2021. Use the formula booklet.

Post your answer into the respective folder and name the file as [topic]-[question].[ipynb]. For example, if you answer the 5th question on 4.3 Wave characteristics your file name would be 4.3-05.ipynb. The answer consists of a text block and a code block. Document your work. If you are not comfortable with Jupyter notebook you can use a regular word document or Google Doc.

1) Start with the question

Copy the question and related pictures into your document. Convert numbers in the text part into math mode (place inside dollars $a=5$) to use _{subscript}, ^{superscript} and \alpha \leq α≤.

2) Answer your question

Include given values, formula, solution and answer. Refer to the formula booklet, if possible.

3) Calculation

Add a code block where you define all variables, add the formula and compute the result. Document your work with # lines. Add a space between # and your comment.

Examples

Tutorial video

Playlist with tutorial and solution videos

As of 2020/03/25: 9 videos, 122 minutes.

Answers to Topic 2 Mechanics are found in this folder.
Answers to Topic 6 Circular motion and gravitation are found in this folder.
Answers to Topic 9 Wave phenomena are found in this folder.
Answers to Topic 12 Quantum and nuclear physics are found in this folder.

A 25-N crate is given an initial velocity of 8.0 ms^{-1} on a floor. It slides 12 m.

11. Find the constant acceleration of the crate.

Given:	u = 8.0 ms^{-1}	explicit
	s = 12 m	explicit
	v = 0 ms^{-1}	implicit (stops after 12m)
Formula:	$v^2 = u^2 + 2as$	timeless from 2.1 Motion
Solution:	0 = 64 + 2a12	
	a = (-64)/24	
	a = -8/3	
	a = <u>-2.7 ms^{-2}</u>	2 significant figures, based on the given values

Answer 11: The constant acceleration of the crate is -2.7 ms^{-2}.

Jupyter notebook answer:

```
*A $25N$ crate is given an initial velocity of $8.0 ms^{-1}$
on a floor. It slides $12 m$.*

### Question 11

Find the constant acceleration of the crate.

__Given__
- $W = 25N$ weight of the crate, explicit
- $u = 8.0 ms^{-1}$ initial velocity, explicit
- $s = 12 m$ distance the crate is sliding,
explicit
- $v = 0 ms^{-1}$ final velocity, implicit

__Formula__
- $v^2 = u^2 + 2as$ timeless from 2.1 Motion

__Solution__

Rearrange the formula:
- $a = \frac{v^2 - u^2}{2s} = \frac{0^2 - 8^2}{2 \times 12}
= - \frac{64}{24} = -2\frac{2}{3} = -2.7 ms^{-2}$

__Answer:__ The acceleration of the crate is $-2.7 m/s^2$.
```

A $25N$ crate is given an initial velocity of $8.0ms^{-1}$ on a floor. It slides $12m$.

Question 11

Find the constant acceleration of the crate.

Given

- $W = 25N$ weight of the crate, explicit
- $u = 8.0ms^{-1}$ initial velocity, explicit
- $s = 12m$ distance the crate is sliding, explicit
- $v = 0ms^{-1}$ final velocity, implicit

Formula

- $v^2 = u^2 + 2as$ timeless from 2.1 Motion

Solution

Rearrange the formula:

- $a = \frac{v^2-u^2}{2s} = \frac{0^2-8^2}{2\times12} = -\frac{64}{24} = -2\frac{2}{3} = -2.7ms^{-2}$

Answer: The acceleration of the crate is $-2.7m/s^2$.

```
[ ] u = 8        # initial velocity in m/s
    s = 12       # dinstance the crate is sliding, in meter
    v = 0        # final velocity in m/s

    a = (v**2 - u**2) / (2 * s)

    print("The acceleration of the crate is {:.1f} m/s²".format(a))
```

```
The acceleration of the crate is -2.7 m/s²
```

12. Find the friction force that stops the crate.

Given:	W = 25 N	explicit (weight of the crate)
	g = - 9.81 ms^{-2}	implicit (gravitational acceleration for the weight)
	a = -2.667 ms^{-1}	implicit (result from question 11)
Formula:	W = mg	weight
	F = ma	Newton's second law
Solution:	m = W/g = 25/9.81 = 2.55	
	m = 2.55 kg	
	F = ma = W/g × a= 25/(-9.81) × (-2.67) = 6.80	
	F = 6.8 N	

Answer 12: The force that stops the crate is 6.8 Newton.

Solution in Jupyter notebook:

```
*A $25N$ crate is given an initial velocity of $8.0 ms^{-1}$ on a floor. It slides $12 m$.*

### Question 12

Find the friction force that stops the crate.

__Given__
- $W = 25N~~~~~~~~~~~$ weight of the crate, explicit
- $g = -9.81 ms^{-2}~~~$ gravitational acceleration
- $a = -\frac{8}{3}ms^{-2}~~~~~~~$ from question 11

__Formula__
- $F = ma~~~~~~~~~~~~~~~$ Newtons second law
- $W = mg$

__Solution__

Rearrange the weight formula for the mass:
- $m = \frac{W}{g}$
- $F = ma = \frac{W}{g}a = 6.8 N$

__Answer:__ The friction force that stops the crate is $6.8 N$.
```

A $25N$ crate is given an initial velocity of $8.0ms^{-1}$ on a floor. It slides $12m$.

Question 12

Find the friction force that stops the crate.

Given

- $W = 25N$ weight of the crate, explicit
- $g = -9.81ms^{-2}$ gravitational acceleration
- $a = -\frac{8}{3}ms^{-2}$ from question 11

Formula

- $F = ma$ Newtons second law
- $W = mg$

Solution

Rearrange the weight formula for the mass:

- $m = \frac{W}{g}$
- $F = ma = \frac{W}{g}a = 6.8N$

Answer: The friction force that stops the crate is $6.8N$.

```
[5]  W = 25      # weight of the crate in Newton
     g = -9.81   # gravitational acceleration in m/s²
     a = -8 / 3  # acceleration of the crate, from question 11

     F = W / g * a

     print("The friction force that stops the crate is {:.3f} N".format(F))
```

```
The friction force that stops the crate is 6.796 N
```

These are examples from December 2019, here only for reference. Use the updated ones above.

Old documents 2.2-11.ipynb or 2.2-11.doc and 2.2-12.ipynb or 2.2-12.doc

A 25-N crate is given an initial velocity of 8.0 ms^{-1} on a floor. It slides 12 m.

11. Find the constant acceleration of the crate.

Given:	u = 8 ms^{-1}	explicit
	s = 12 m	explicit
	v = 0 ms^{-1}	implicit (stops after 12m)
Want:	a	acceleration
Formula:	$v^2 = u^2 + 2as$	timeless
Solution:	0 = 64 + 2a12	
	a = (-64)/24	
	a = -8/3	
	a = -2.7 ms^{-2}	

Answer 11: The constant acceleration of the crate is -2.7 ms^{-2}.

In Jupyter notebook:

A 25-N crate is given an initial velocity of 8.0 ms-1 on a floor. It slides 12 m.

11. Find the constant acceleration of the crate.

Given:

- $u = 8ms^{-1}$ *explicit*
- $s = 12m$ *explicit*
- $v = 0ms^{-1}$ *implicit* (stops after 12m)

Want:

- a acceleration

Formula:

- $v^2 = u^2 + 2as$ *timeless*

Transformed for a:

$$a = \frac{v^2 - u^2}{2s}$$

Solution:

- $0 = 64 + 2a12$
  $a = (-64)/24$
  $a = -\frac{8}{3}$
  $a = -2.7ms^{-2}$

Answer 11: The constant acceleration of the crate is $-2.7ms^{-2}$.

```
In [1]: u = 8            # initial velocity
        s = 12           # distance traveled
        v = 0            # final velocity

        a = (v**2 - u**2) / (2 * s)
        a

Out[1]: -2.666666666666665
```

12. Find the friction force that stops the crate.

Given:	u = 8 ms^{-1}	explicit
	s = 12 m	explicit
	v = 0 ms^{-1}	implicit (stops after 12m)
	g = 9.81 ms^{-2}	implicit (gravitational acceleration for the weight)
	W = 25 N	explicit (weight of the crate)
	a = -2.7 ms^{-1}	implicit (result from question 11)
Want:	m	mass of the crate
	F	force
Formula:	W = mg	weight
	F = ma	Newton's second law
Solution:	m = W/g = 25/9.81 = 2.55	
	m = 2.55 kg	
	F = ma = 2.55 × (-2.67) = 6.80	
	F = 6.8 N	

Answer 12: The force that stops the crate is -6.8 Newton.

12. Find the friction force that stops the crate.

Given:

- $g = 9.81ms^{-2}$ implicit (gravitational acceleration for the weight)
- $W = 25N$ explicit (weight of the crate)
- $a = -2.7ms^{-1}$ implicit (result from question 11)

Want:

- m mass of the crate
- F force that stops the crate

Formula:

- $W = mg$ weight
- $F = ma$ Newton's second law

Solution:

- $m = W/g = 25/9.81 = 2.55$
  $m = 2.55kg$
  $F = ma = 2.55 \times (-2.67) = 6.80$
  $F = 6.8N$

Answer 12: The force that stops the crate is $-6.8N$.

```
g = 9.81            # gravitational acceleration (formula booklet)
W = 25              # weight of the crate in Newton
a = -2.6666667      # acceleration of the crate

m = W / g
print('Mass of the crate:',m,'kg')
F = m * a
print('Force to stop the crate:',F,'N')
```

```
Mass of the crate: 2.54841997961264 kg
Force to stop the crate: -6.7957866972477055 N
```