Understanding Assessment and Improving Delivery in IAL Physics

Marking exercise

AO2b questions

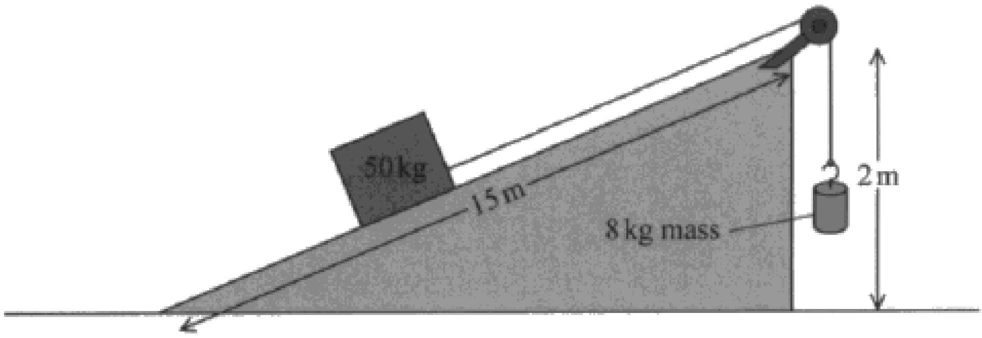
YPH11/19IF02

WPH11 1906 Q12

Example 1

12 Machines make work easier by changing the size or direction of a force. A student designed a simple machine to lift a box of mass 50 kg. The student claimed the efficiency of the machine was greater than 90%.

The machine used a slope of height 2.0 m and length 15 m to move the box. The box was connected to an 8.0 kg mass by a rope over a pulley as shown. As the 8.0 kg mass fell, the box moved up the slope at a steady speed.



Determine whether the maximum efficiency of the machine was greater than 90%.

(4)

~~$W_{mass} = 2 \times 8 \times 9.81 = 156.96\,J$~~

$W_{output} = 50\,kg \times 9.81\,N\,kg^{-1} \times 2\,m =$ ~~980J~~ $981\,J$

~~W_{mass}~~

$W_{input} = 8\,kg \times 9.81\,N\,kg^{-1} \times 15\,m = 1177.2\,J$

~~efficien~~ efficiency $= \frac{W_{output}}{W_{input}} = \frac{981}{1177.2} = 83.3\%$ (3 s.f.)

$83.3\% < 90\%$

∴ Efficiency was smaller than 90%

(Total for Question 12 = 4 marks)

Example 2

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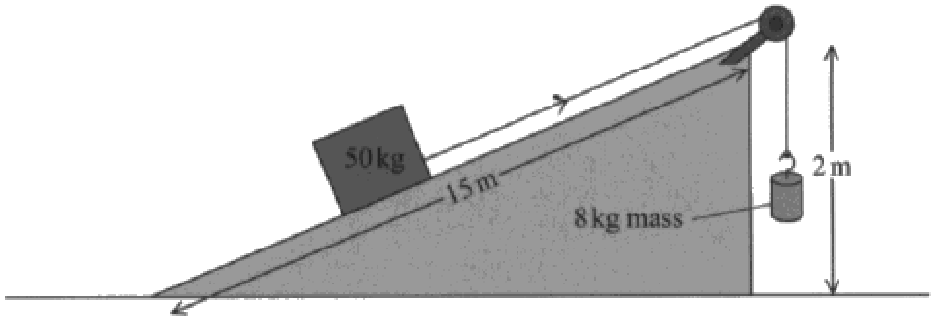

Determine whether the maximum efficiency of the machine was greater than 90%.

(4)

work done = mgh. / Fas.

~~cosθ = 2/15 =~~ sinθ = 2/15 = 7.66.

work done by the 8kg mass.

8kg × 9.81 × 2 = ~~156.8~~ J.

156.96 J

~~50 × 9.8 × 15~~

~~50×~~ $\frac{50 \times 9.8 \times 2}{156.8} = \frac{980}{156.96} = 6.24.$

Example 3

12 Machines make work easier by changing the size or direction of a force. A student designed a simple machine to lift a box of mass 50 kg. The student claimed the efficiency of the machine was greater than 90%.

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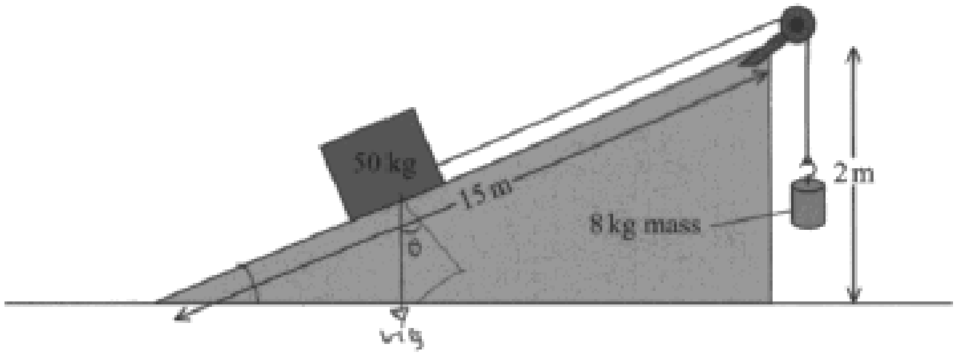


Determine whether the maximum efficiency of the machine was greater than 90%.

(4)

GPE = mgh   Work done = force × distance

$= (8)(9.81)(2)$ $= (50)(9.81)\sin(7.66) \times (15) = 980.7\ J$ (1dp)

$= 156.96\ J$ $\sin\theta = \frac{2}{15}$

$\theta = 7.66°$ (3.s.f)

force = $mg\sin(7.66°)$

% efficiency = $\frac{GPE}{\text{work done}} \times 100 = \frac{156.96\ J}{980.7\ J} \times 100 = 16\%$ (2 s.f)

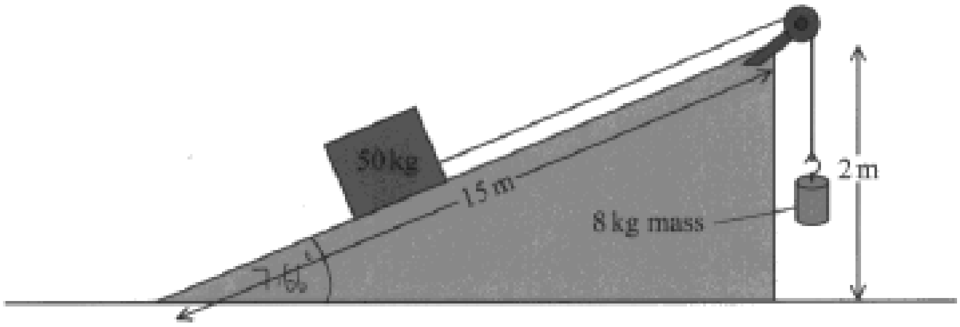
16% < 90%, therefore efficiency is not greater than 90%

(Total for Question 12 = 4 marks)

Example 4

12 Machines make work easier by changing the size or direction of a force. A student designed a simple machine to lift a box of mass 50 kg. The student claimed the efficiency of the machine was greater than 90%.

The machine used a slope of height 2.0 m and length 15 m to move the box. The box was connected to an 8.0 kg mass by a rope over a pulley as shown. As the 8.0 kg mass fell, the box moved up the slope at a steady speed.



Determine whether the maximum efficiency of the machine was greater than 90%.

(4)

~~Ener~~ work done against gravity:

$\sin\theta = \frac{2}{15}$ $\theta = 7.66^\circ$

energy = mgh

= 50 × 9.81 × 2 × sin 7.66

= 981 J × sin 7.66

981 × sin(7.66)

= 130 J

Input energy:

= mgh

= 8 × 9.81 × 2

= 156.96 J

efficiency = $\frac{130}{156.96}$ × 100 = 82.8% efficienc:

✗ NO, this is not greater than 90%.

(Total for Question 12 = 4 marks)

WPH01 1906 Q17b

Example 1

Comment on the manufacturers' recommendation. Your answer should include calculations.

(6)

A new rope has a higher breaking stress so it's stronger. It ~~can have more~~ has less extension for the same applied load, compared to 5 year-old rope. The new rope has a higher elastic potential energy. ~~therefore it can exte~~ The new rope is stiffer than the old rope.

$k = \frac{F}{x} = \frac{13000}{0.115} = 113000\ Nm^{-1}$

when force is 13000 N, for new rope

$k = \frac{F}{x} = \frac{13000}{0.18} = 72200\ Nm^{-1}$

when force is 13000N for old rope

113000 > 72200

stiffness constant greater for ~~old~~ new rope

(Total for Question 17 = 13 marks)

Example 2

Comment on the manufacturers' recommendation. Your answer should include calculations.

(6)

Using a new rope would be safer than using an old one as its material would wear out. The rope after 5 years stretches more than the new rope for a particular force applied. when a force of 5000N was applied, the new rope extended for 0.07 m only. But the rope after 5 years extended for 0.13 m.

The new rope would be more stiffer than that of the old rope.

the new rope would have a higher breaking point than the old rope.

$k = F/\Delta x$

$= \frac{5000}{0.07}$

$= 71429\ Nm^{-1}$

New rope

$k = F/\Delta x$

$= \frac{5000}{0.13}$

$= 38462$.

Rope after 5 years.

The new rope has a higher constant than the rope after 5 years.

Example 3

Comment on the manufacturers' recommendation. Your answer should include calculations.
(6)

- New ropes have a higher breaking stress, and therefore are much stronger than old ropes, which can easily break.
- New ropes can also withstand, greater, stress, and display smaller extension, and hence are less likely deform, compared to old ropes.
- New ropes can also withstand, and absorb larger energy compared to old ropes.

Energy absorbed by new rope:

$\frac{1}{2} \times F \times \Delta x = \frac{1}{2} \times 18,000 \times 0.135$

$= 1215\ J$

Energy absorbed by old rope:

$= \frac{1}{2} \times 12,500 \times 0.185$

$= 1156\ J$,

Example 4

Comment on the manufacturers' recommendation. Your answer should include calculations.

(6)

The energy stored it each rope can be calculated by the area under the graph.

New rope = $\frac{1}{2} Fx$

$= \frac{1}{2} \times 18500 \times 0 \cdot 13$

$= 1202 \cdot 5$ J

rope after 5 years = $\frac{1}{2} \times 80000 \times 0 \cdot 185$

$= 7400$ J

The energy is new rope is more than that of the old rope. The extention is old rope is more which can be dangerous, hence using new ropes will be a good idea.

WPH12 1906 Q11

Example 1

11 A student carried out an experiment to determine the resistivity of a metal in the form of a wire. She made the following measurements:

length of wire = 0.20 m
resistance of wire = 50 mΩ
diameter of wire = 0.36 mm

Determine the metal of the wire using information from the table below.

Metal	Resistivity / Ω m
aluminium	2.7×10^{-8}
tungsten	5.6×10^{-8}
iron	1.0×10^{-7}

(3)

$\rho = \frac{Rl}{A}$, $R = 50\,m\Omega = \frac{50}{1000} = 0.05\,\Omega$

$= 0.05 \times \frac{0.20}{0.36}$ ≠ ~~0.0278~~ = 2.7×10^{-8}

∴ The metal is aluminium.

Example 2

$R = \frac{\rho l}{A}$ $\frac{R \times A}{l} = \rho$

$A = 1.02 \times 10^{-7}$ $\frac{\frac{50}{1000} \times 1.02 \times 10^{-7}}{0.2} = 2.55 \times 10^{-7}$

The metal is aluminium.

Example 3

(3)

$R = \rho \frac{l}{A}$

Area = $\pi r^2 h$

$50\,\Omega m = \rho \left(\frac{0.20}{2.26 \times 10^{-4}} \right)$

$= \pi (0.36) h$

$= \pi \left(\frac{0.36}{1000} \right) \times 0.20$

$50 = \rho\,(884.955)$

$= 2.26 \times 10^{-4}$

$\rho(884.955) = \frac{50}{10000}$

$\rho = \frac{0.056}{1000} = 5.6 \times 10^{-6}\ \Omega m$

∴ The metal is alumenium

(Total for Question 11 = 3 marks)

WPH12 1906 Q16c

Example 1

(c) Light from the tube was directed through a diffraction grating, labelled as having 300 lines per mm. The diffraction pattern produced was displayed on a flat screen. The student measured the distance s between the central maximum and the first-order maximum on the screen. He also measured the distance D from the diffraction grating to the screen.

Determine whether the labelling of the diffraction grating as having 300 lines per mm was correct.

$s = 0.234$ m
$D = 1.30$ m
$\lambda = 589$ nm

(3)

$D_x = \frac{D\lambda}{d}$ $\quad d = \frac{D\lambda}{D_x}$

$D_x = 0.234$ $\quad d = \frac{1.3 \times 589 \times 10^{-9}}{0.234}$

$d = 3.27 \times 10^{-6}$ m $= \frac{1 \times 10^{-3}}{n}$

$n = 305.6 \approx 306$ lines per mm it was not

completely accurate

Example 2

c) Light from the tube was directed through a diffraction grating, labelled as having 300 lines per mm. The diffraction pattern produced was displayed on a flat screen. The student measured the distance s between the central maximum and the first-order maximum on the screen. He also measured the distance D from the diffraction grating to the screen.

Determine whether the labelling of the diffraction grating as having 300 lines per mm was correct.

$s = 0.234$ m
$D = 1.30$ m
$\lambda = 589$ nm

$n\lambda = d\sin\theta$

$n = 1$ $\sin\theta = \frac{0.234}{\sqrt{0.234^2 + 1.3^2}} = 0.177$

$d = \frac{n\lambda}{\sin\theta} = \frac{589\times10^{-9}}{0.177} = 3.38\times10^{-6}$ m

$\frac{1\times10^{-3}}{300} \approx 3.33\times10^{-6}$ m

so it is correct.

Example 3

$\tan\theta = \frac{O}{A}$

$\tan\theta = \frac{0.234}{1.30}$

$\theta = \tan^{-1}\left(\frac{0.234}{1.30}\right)$

$\theta = 10.2°$

$d\sin\theta = n\lambda$

$d = \frac{n\lambda}{\sin\theta}$

$d = \frac{1\times589\times10^{-9}}{\sin 10.2}$

$d = 3.33\times10^{-6}$

$\frac{1\times10^{-3}}{3.33\times10^{-6}} = 300$ lines per mm, correct.

WPH12 1906 Q17bii

Example 1

(ii) The teacher suggested using a microphone connected to an oscilloscope to determine where the loud and quiet zones were located along the line XY. She said that this method would result in much less uncertainty than when students walked along the line XY.

Explain one reason why this is a suitable suggestion.

(2)

The oscilloscope can show the amplitude with precision which is better and more accurate than a student hearing

Example 2

(2)

Because if ~~the~~ a student is ~~wto~~ walking then the uncertainity is half of his foot which is a lot considering they have a small ~~exp~~ experiment/place. ~~When~~ If the microphone connected to an oscilloscope is used, they can pin point the exact locatio

Example 3

human cannot ~~tell~~ ~~a~~ ~~#~~ differeiate accurately the most quiet point, but oscilloscope can. so can ensure more precise point and results.

WPH12 1906 Q17c

Example 1

(c) A student suggested that equally valid results would be obtained if the experiment was performed in the classroom.

Criticise this suggestion.

(2)

No, because in a classroom the sound waves would be ~~reflete~~ reflected off of walls which would interfere with the loud and quiet spots.

Example 2

(c) A student suggested that equally valid results would be obtained if the experiment was performed in the classroom.

Criticise this suggestion.

(2)

The sound would echo and reflect back therefore emitted pulse and reflected pulse would be difficult to identify.

Example 3

(c) A student suggested that equally valid results would be obtained if the experiment was performed in the classroom.

Criticise this suggestion.

(2)

Classroom can cause echoes which will reflect and interfere with the waves being produced