Centre No.						Paper Reference	Surname	Other names
Candidate No.						6 7 3 3 / 2 A	Signature	

Edexcel GCE

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test

Friday 11 January 2008 – Afternoon

Time: 1 hour 30 minutes

For Examiner's use only
For Team Leader's use only

Question numbers	Leave blank
A	
B	
Total	

For the Supervisor's use		
B	Tick if either circuit set up for candidate (Give details below)	
Comments		

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, other names and signature.

PHY3 consists of questions A and B. Each question is allowed 35 minutes plus 5 minutes writing-up time. There is a further 10 minutes for writing-up at the end. The Supervisor will tell you which experiment to attempt first.

Write all your results, calculations and answers in the spaces provided in this question booklet.

In calculations you should show all the steps in your working, giving your answer at each stage.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets.

The total mark for this paper is 48.

The list of data, formulae and relationships is printed at the end of this booklet.

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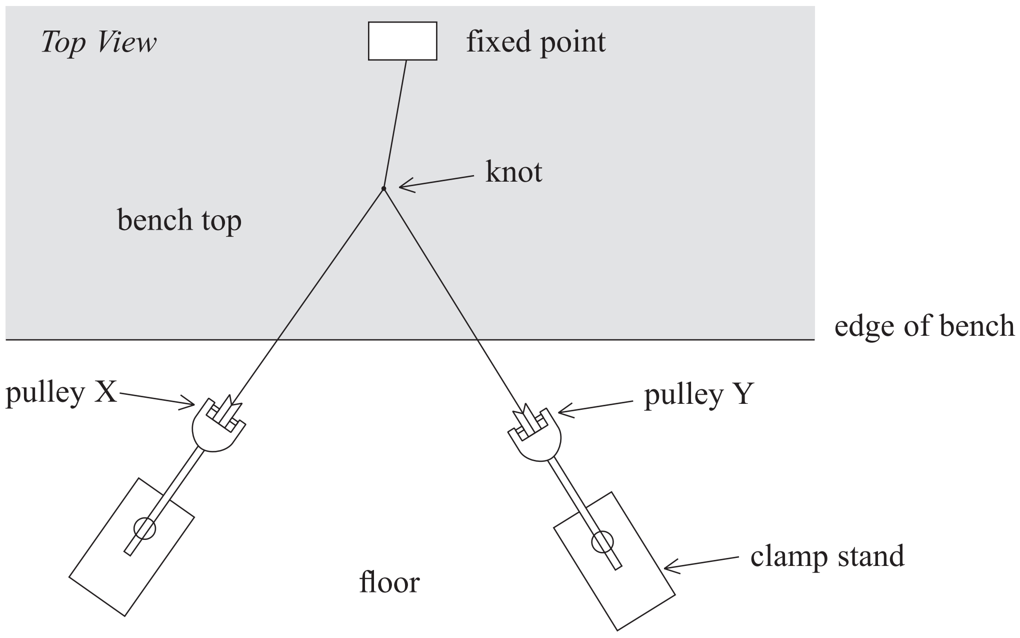
Question A

(a) (i) The apparatus shown in the diagram below has been set up for you. Do not move the fixed point or change the masses.



- Adjust the position of the stands and pulleys until the string leading to the 70 g mass and the string leading to the 40 g mass are approximately at right angles to each other.
- Place page 3 of the question paper underneath the strings. Adjust the position of the question paper until the knot which joins the strings together is vertically above the point labelled O.

The string leading to the 70 g mass should lie vertically above the line OA and the string leading to the 40 g mass should lie vertically above the line OB.

- Re-adjust the apparatus so that all these conditions are met. Ensure that the system is in stable equilibrium and that all strings lie in the same horizontal plane.
- Mark a point C on the page that is vertically below the string that passes to the fixed point.

Remove the question paper from beneath the strings.

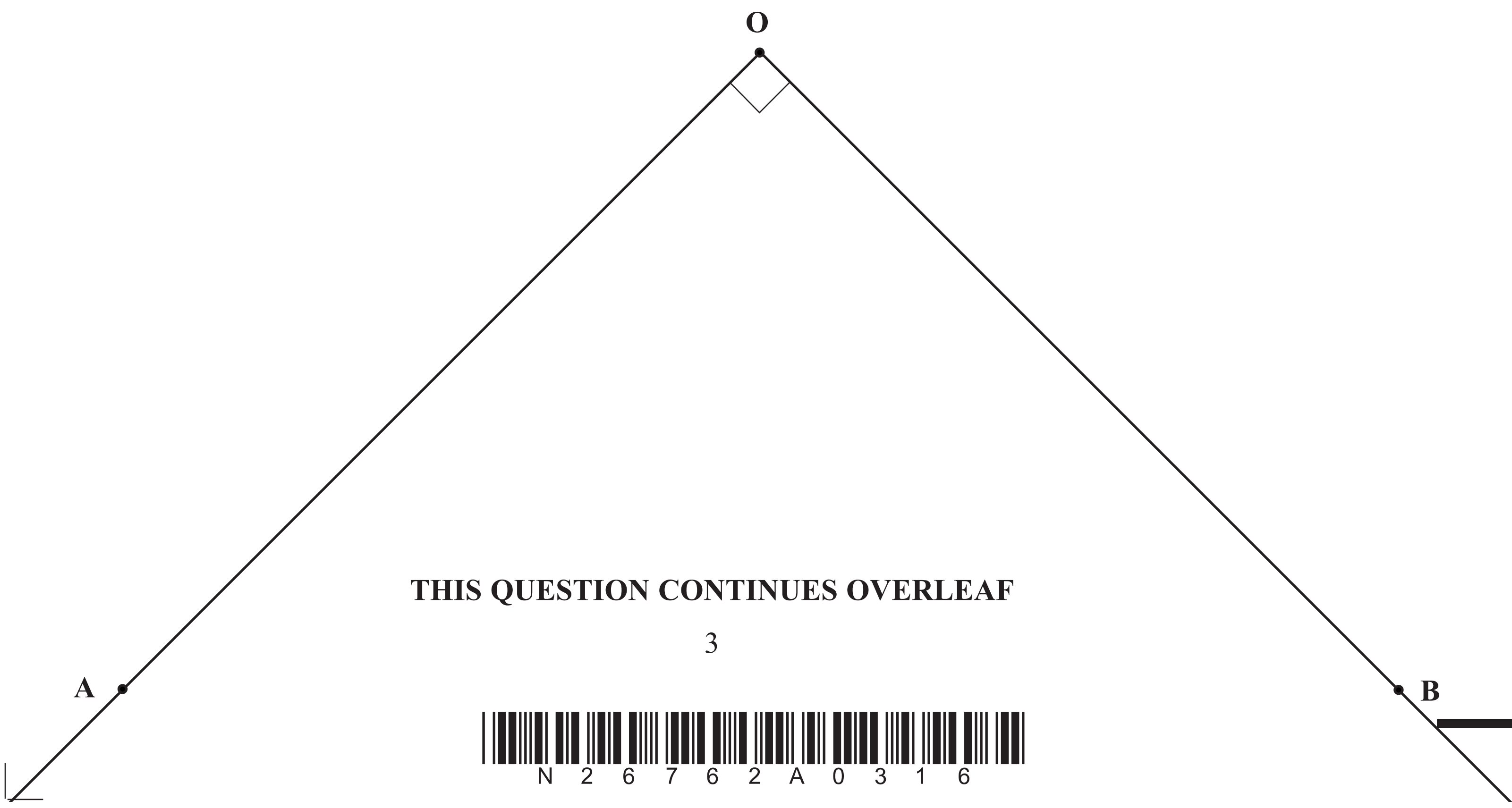
(1)

(ii) Draw a line connecting point O to point C. Measure θ, where $\theta = \angle BOC$.

θ = ...

(2)

θ = ...



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(iii) Explain how you ensured that:

- the system was in stable equilibrium,

 ....

 ....

- all the strings were in the same horizontal plane,

 ....

 ....

- the knot was vertically above the point labelled O,

 ....

 ....

- friction at the pulley wheels was minimised.

 ....

 ....

(4)

(iv) Assuming that the pulleys are frictionless, calculate the tensions T_1 and T_2 in the strings OA and OB respectively.

$T_1 =$ ....

$T_2 =$ ....

(1)

Leave blank

On the grid below draw to scale a vector diagram to determine the resultant T of these two tensions. State the scale that you are using. Measure the angle φ between the tension T_2 and the resultant tension.

Resultant tension T = ...

Angle φ = ...

(6)

N 2 6 7 6 2 A 0 5 1 6

Turn over

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(b) (i) Measure out 80 cm^3 of water at room temperature from the beaker and pour the water into the plastic cup. Record the temperature θ_1 of the water in the cup.

θ_1 = ...

Take a heaped spoonful of crushed ice and place it into the cup. Record the final temperature θ_2 of the water when all the ice has melted.

θ_2 = ...

State any precautions that you took when carrying out the experiment.

....

....

....

....

(3)

(ii) Measure the final volume of water in the plastic cup; hence deduce the volume of the melted ice.

Final volume: ....

Volume of melted ice: ....

Given that 1.0 cm^3 of water or melted ice has a mass of 1.0 g write down the initial mass m_w of the water and the mass m_i of the melted ice.

....

....

(1)

Leave blank

(iii) The specific heat capacity of water is 4.2 J g^{-1} K^{-1} (4200 J kg^{-1} K^{-1}). Calculate the loss of thermal energy of the water that was initially in the plastic cup.

....

....

Calculate the gain in the thermal energy of the water that was obtained from the melted ice.

....

....

(2)

(iv) Deduce how much energy was needed to melt the ice, hence calculate a value for the specific latent heat of fusion *L* of ice.

....

....

....

....

(2)

(v) By considering possible sources of error in the experiment, explain whether your value of θ_2 is likely to be too high or too low.

....

....

....

....

(2)

QA

(Total 24 marks)

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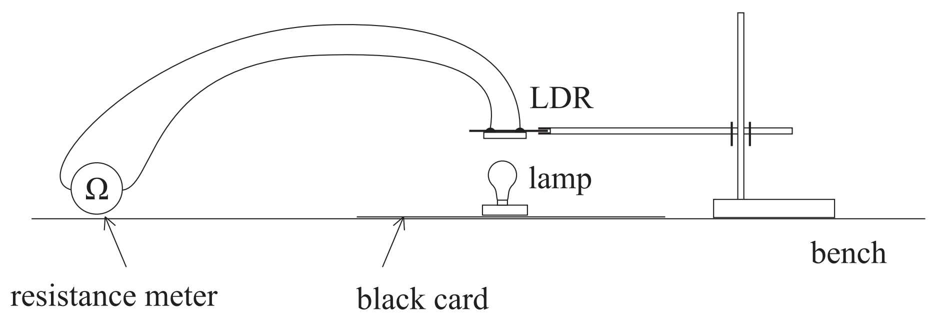
Question B

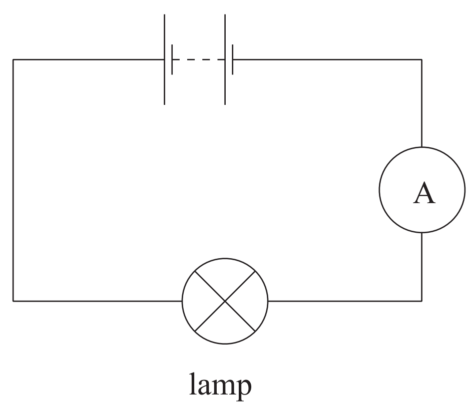
(a) Connect the resistance meter (ohmmeter) to the light dependent resistor (LDR). Clamp the LDR so that the light detecting face is facing downwards and is about 5 cm above the lamp. The arrangement is shown in Figure 1 below.

Figure 1



Set up the circuit containing the lamp as shown in Figure 2 below. Before you connect this circuit to the 6 V power supply, have your circuits checked by the Supervisor. You will be allowed a short time to correct any faults. If you are unable to set up the circuits, the Supervisor will set them up for you. You will lose only two marks for this.

Figure 2



(2)

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(b) Connect the 6.0 V output of the power supply to the circuit. Adjust the height of the LDR so that the resistance of the LDR is approximately 1 kΩ. When taking readings from the meters try not to cast a shadow over the apparatus as this will affect the resistance reading. If the resistance reading is fluctuating estimate an average value for the reading. Record the current I in the lamp and the resistance R of the LDR. Use the graph opposite to determine the corresponding light intensity L.

I = ...

R = ...

L = ...

(3)

(c) (i) Disconnect the power supply and, **without changing the position of the LDR or lamp**, record the resistance of the LDR. Use the graph to determine the corresponding light intensity. This may be thought of as the background light intensity $L_{background}$.

Resistance of LDR = ...

$L_{background}$ = ...

(ii) Calculate the light intensity L_{lamp} at the LDR due to the lamp alone using $L_{lamp} = L - L_{background}$.

....

....

(iii) Assuming that the output voltage of the power supply is 6.0 V, use your value for I from part (b) to calculate the electrical power P supplied to the lamp.

....

....

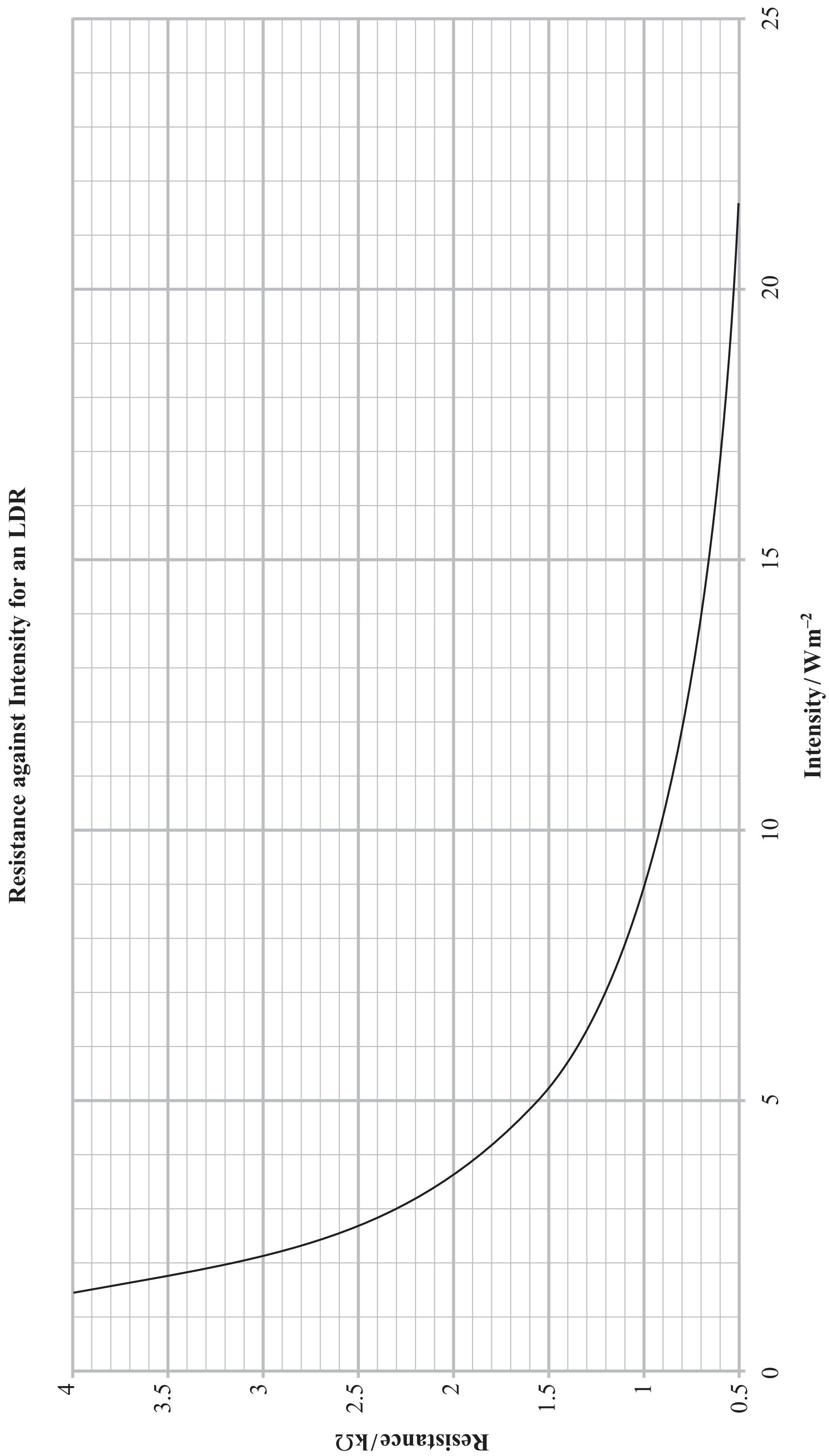
(4)

(d) **Without changing the position of the LDR or lamp** connect the 4.5 V output of the power supply to the circuit. Record new values for I, R and L.

I = ...

R = ...

L = ...


Resistance against Intensity for an LDR
Resistance/kΩ
Intensity/W m⁻²
4
3.5
3
2.5
2
1.5
1
0.5
0
5
10
15
20
25

Leave blank

Assuming that $L_{background}$ remains the same, calculate the new value of L_{lamp}.

L_{lamp} ....

....

Calculate the new value of P assuming that the output voltage of the power supply is 4.5 V.

....

....

(5)

(e) A student suggests that L_{lamp} is directly proportional to P.

(i) Write an equation to represent this direct proportionality.

....

(ii) Use your two sets of data to determine two values for the constant of proportionality k.

....

....

....

....

(iii) Calculate the percentage difference between your two values of k and comment on whether this percentage difference supports the student's suggestion.

....

....

....

....

....

....

....

(5)

Leave blank

(f) You are to plan an experiment to further investigate the student's suggestion. Your plan should include:

- A description of the experiment to be performed.
- A sketch of the graph to be plotted to test the results.
- An indication of how k could be determined from the graph.

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(5)

QB

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to the Earth)
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to the Earth)
Elementary (proton) charge	$e = 1.60 \times 10^{-19} \text{ C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$	

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

$$x = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2ax$$

Forces and moments

Moment of F about O $= F \times$ (Perpendicular distance from F to O)

Sum of clockwise moments about any point in a plane = Sum of anticlockwise moments about that point

Dynamics

Force $F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $F\Delta t = \Delta p$

Mechanical energy

Power $P = Fv$

Radioactive decay and the nuclear atom

Activity $A = \lambda N$ (Decay constant λ)

Half-life $\lambda t_{\frac{1}{2}} = 0.69$

Electrical current and potential difference

Electric current $I = nAQv$

Electric power $P = I^2R$

Electrical circuits

Terminal potential difference $V = \mathcal{E} - Ir$ (E.m.f. $\mathcal{E}$; Internal resistance r)

Circuit e.m.f. $\Sigma\mathcal{E} = \Sigma IR$

Resistors in series $R = R_1 + R_2 + R_3$

Resistors in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Heating matter

Change of state: energy transfer $= l\Delta m$ (Specific latent heat or specific enthalpy change l)

Heating and cooling: energy transfer $= mc\Delta T$ (Specific heat capacity c; Temperature change ΔT)

Celsius temperature $\theta/°\text{C} = T/\text{K} - 273$

Kinetic theory of matter

$T \propto$ Average kinetic energy of molecules

Kinetic theory $p = \frac{1}{3}\rho\langle c^2\rangle$

Conservation of energy

Change of internal energy $\Delta U = \Delta Q + \Delta W$ (Energy transferred thermally ΔQ; Work done on body ΔW)

Efficiency of energy transfer $= \frac{\text{Useful output}}{\text{Input}}$

For a heat engine, maximum efficiency $= \frac{T_1 - T_2}{T_1}$

Experimental physics

$$\text{Percentage uncertainty} = \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$$

Mathematics

$\sin(90° - \theta) = \cos\theta$

Equation of a straight line $y = mx + c$

Surface area cylinder $= 2\pi rh + 2\pi r^2$

sphere $= 4\pi r^2$

Volume cylinder $= \pi r^2 h$

sphere $= \frac{4}{3}\pi r^3$

For small angles: $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

$\cos\theta \approx 1$

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