NAME	CLASS	INDEX NO.

ST. PATRICK'S SCHOOL
END-OF-YEAR EXAMINATIONS 2016

SUBJECT : PHYSICS 5059

LEVEL : SECONDARY 3 EXPRESS

DATE : 10 OCT 2016

DURATION : 2 HOURS

INSTRUCTIONS TO CANDIDATES

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

1. Write your name, class and index number on the **Question Paper** and the **Optical Answer Sheet** in the spaces provided. **It is also required that you WRITE and SHADE your index number on the Optical Answer Sheet.**
2. Answer **ALL** questions in **Section A** on the **Optical Answer Sheet** provided.
3. Answer **ALL** questions in **Section B** in the spaces provided.
4. Answer **ALL** questions in **Section C** on the spaces provided. Question 11 is an **EITHER / OR QUESTION. SELECT ONLY ONE PART OF THIS QUESTION.**
5. Throughout the paper, the **acceleration due to gravity on Earth** is taken as 10 N/kg **unless stated otherwise.**
6. Calculators may be used where necessary. **Where numerical answers are not exact, give answers to THREE (3) significant figures.**
7. **DO NOT DETACH** any sections from this paper.
8. Submit the **Optical Answer Sheet** and **this paper SEPARATELY** at the end of the examination.

For Examiner's Use Only

Section	A [20 m]	B [50 m]	C [30 m]	Total [100 m]	Grade
Score					

This paper consists of 26 printed pages, including the cover page

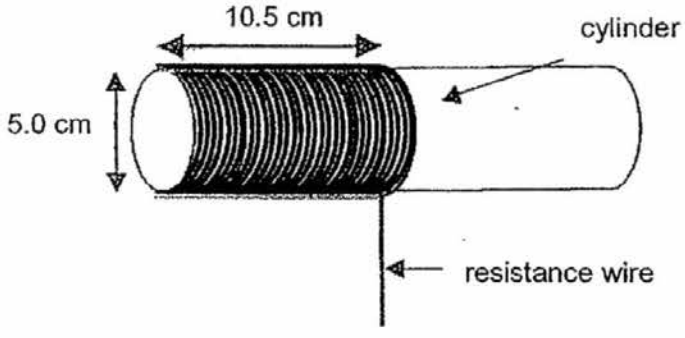
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SECTION A : [20 marks]

*Each question is provided with **four** possible answers (**A**, **B**, **C** and **D**). Select the most appropriate answer and **shade** your choice on the **Optical Answer Sheet** provided.*

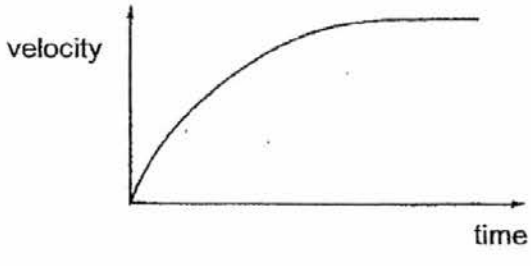
1 Joyce wanted to measure the thickness of a resistance wire. She wound the wire around a cylinder, of diameter 5.0 cm, 50 times and took the following measurements as shown in the figure.



Which one of the following is the thickness of the wire?

A 0.050 cm **B** 0.100 cm **C** 0.105 cm **D** 0.210 cm

2 The graph shows how the velocity of a car changes with time.

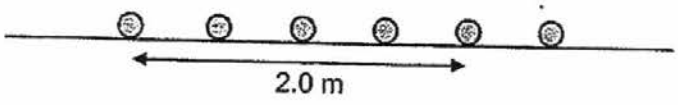


Which one of the following can be deduced from the graph?

A The car decelerates until it stops.
B The car accelerates at an increasing rate.
C The car first accelerates and then moves with a steady velocity.
D The car first decelerates and then moves with a steady velocity.

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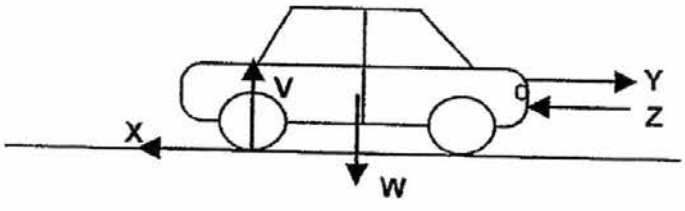
3 The figure shows a series of photographs of a ball rolling with constant velocity. The camera was capturing images at a constant rate of 10 per second.



What was the speed of the ball?

A 1.0 m/s **B** 2.0 m/s **C** 4.0 m/s **D** 8.0 m/s

4 The figure shows a car moving to the right. Some forces are acting on the car.



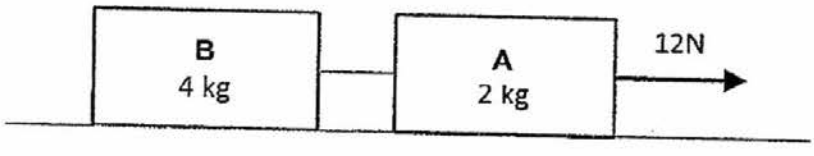
The reduction of which force(s) will cause the speed of the car to decrease?

A **Y** only **B** **Z** only **C** **X** and **Z** only **D** **W** and **V**

5 The total weight of a gas-filled balloon is 1200 N. The balloon rises at a constant speed of 2 m/s. What is the resultant force acting on the balloon when it is rising?

A 0 N **B** 60 N **C** 600 N **D** 2 400 N

6 A force of 12 N acts on block **A** and block **B** of mass 2 kg and 4 kg respectively as shown.



Given that the floor is smooth, what is the tension of the string between block **A** and block **B**?

A 2.0 N
B 4.0 N
C 8.0 N
D 12.0 N

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7 The table shows the density of some substances.

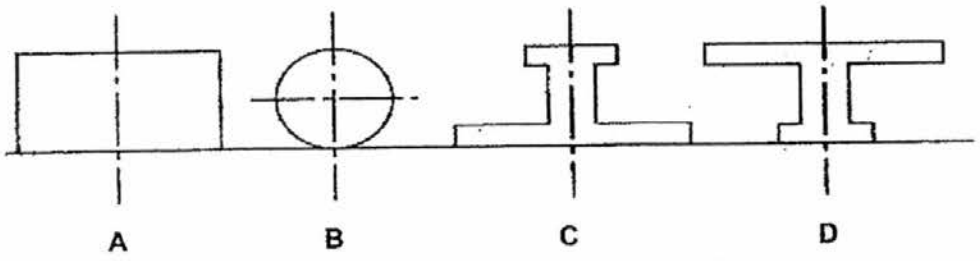
substance	density (kg/m^3)
ebonite	1150
glass	2500
glycerine	1260
kerosene	800
rubber	1300

Which one of the following statements is not true?

A Rubber sinks in glycerine.
B Glycerine floats on top of kerosene.
C Glass sinks in both glycerine and kerosene.
D Ebonite solid sinks in kerosene but floats in glycerine.

8 The figure shows four shapes, cut from the same piece of card.

Which shape has its centre of mass nearest to the base line?



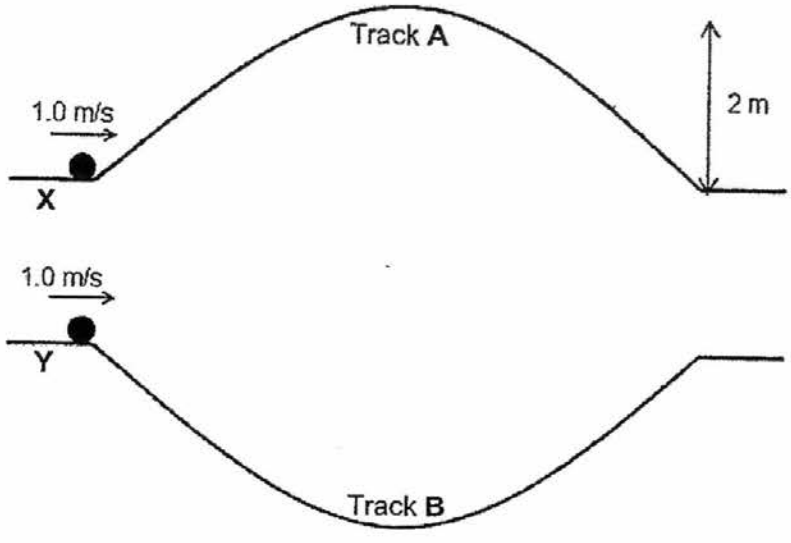
9 Randy pushes a shopping cart of mass 14 kg for 10 m. The work done by Randy is 2 kJ.

Calculate the force exerted by Randy on the cart.

A 0.20 N **B** 14.3 N **C** 140 N **D** 200 N

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10 The figure shows two identical marbles **X** and **Y** enter two types of trajectory **A** and **B** respectively with the same initial speed of 1.0 m/s. Assume all the surfaces involved are frictionless.



Given that Track **A** and Track **B** are mirror images of each other, which one of the following statements is true?

A The final speed of **X** is higher than **Y**.
B **X** reaches the other end of the track before **Y**.
C **Y** reaches the other end of the track before **X**.
D Both **X** and **Y** reaches the other end of the track at the same time.

11 Which of the following statement(s) is/are correct?

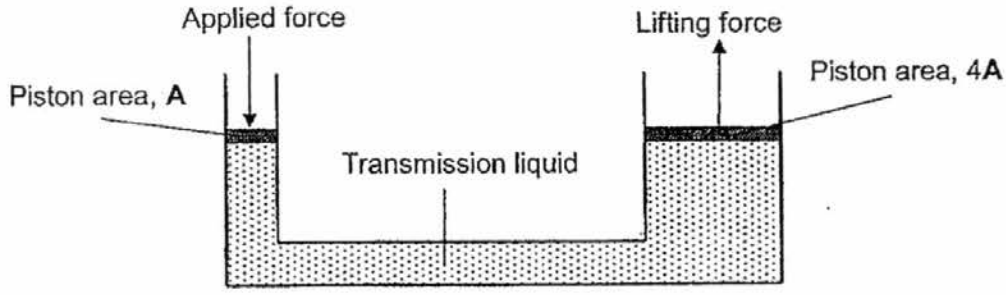
I. Power is the rate of work done.
II. Power is created in the power station.
III. Power is only found in electrical circuits.
IV. Power is a measure of the efficiency of objects.

A I only.
B II and IV only.
C III and IV only.
D I, II and IV only.

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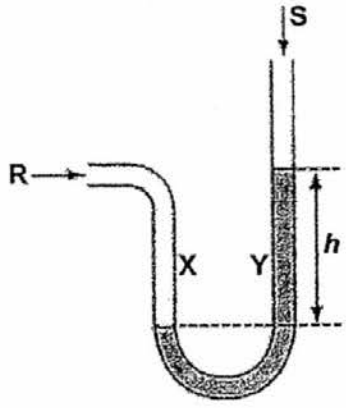
12 The figure shows a hydraulic press used in a workshop to lift up heavy objects.



Which one of the following could be a correct combination of the applied force, lifting force and the distance moved by both pistons?

	Applied force	Lifting force	Distance moved by small piston	Distance moved by large piston
A	10 N	40 N	2 cm	8 cm
B	10 N	40 N	8 cm	2 cm
C	40 N	10 N	2 cm	8 cm
D	40 N	10 N	8 cm	2 cm

13 The figure shows a simple manometer. Side **X** is connected to a gas supply. Side **Y** is open to the atmosphere.

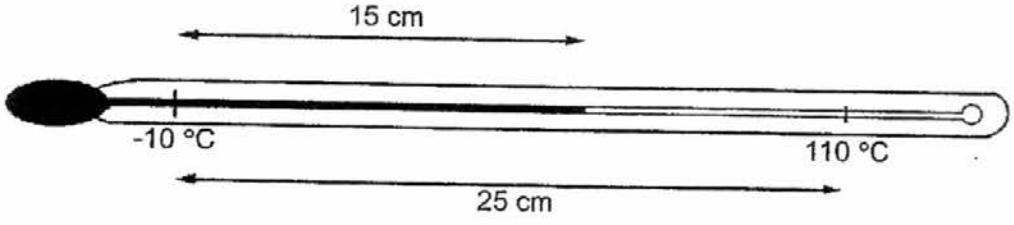


What pressure is the length ***h*** used to measure?

A The gas pressure **R**.
B The atmospheric pressure **S**.
C The sum of the gas pressure **R** and the atmospheric pressure **S**.
D The difference between the gas pressure **R** and the atmospheric pressure **S**.

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14 The figure shows a mercury-in-glass thermometer. The distance between the -10 °C and the 110 °C markings is 25 cm.



At which temperature is the end of the mercury thread 15 cm from the -10 °C mark?

A 50 °C **B** 60 °C **C** 62 °C **D** 72 °C

15 Three liquids with their respective freezing and boiling points are shown in the table.

	Freezing Point / °C	Boiling Point / °C
Aniline	-6	184
Alcohol	-180	78
Mercury	-39	357

A thermometer that can record both -40 °C and 42 °C should be filled with _____.

A alcohol only **B** aniline only **C** mercury only **D** alcohol or mercury

16 Pauline gave some description on how a vacuum flask minimise heat loss.

Which of the following statements does not describe how a vacuum flask minimise heat loss?

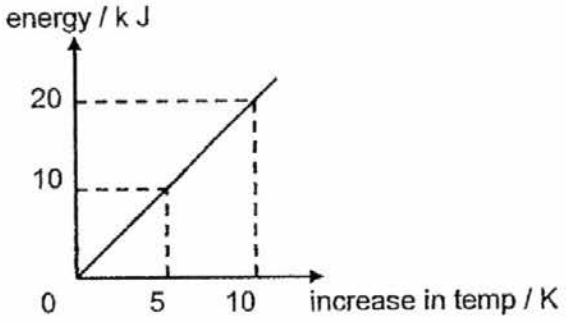
I The double-glass walls prevent heat loss through radiation.
II The stopper is made of plastic which is a poor conductor of heat.
III The vacuum flask is sealed to reduce heat loss through evaporation.
IV Heat loss by convection is negligible as it only occurs when the plastic stopper is removed during use.

A I and II **B** I and III **C** I, II and III **D** All of the above

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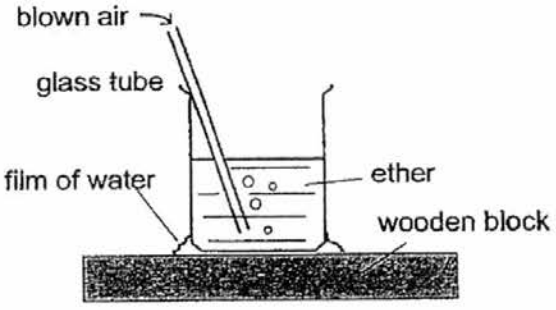
17 The graph shows the amount of energy used to heat up a liquid **X** and the corresponding increase in temperature. The mass of the liquid is 0.40 kg.



What is the specific heat capacity of liquid **X**?

A 2.0 J/ kgK **B** 5.0 J/ kgK **C** 2 000 J/ kgK **D** 5 000 J/ kgK

18 Air is blown into ether through a tube as shown in the figure. After some time, it is observed that the film of water freezes into ice.

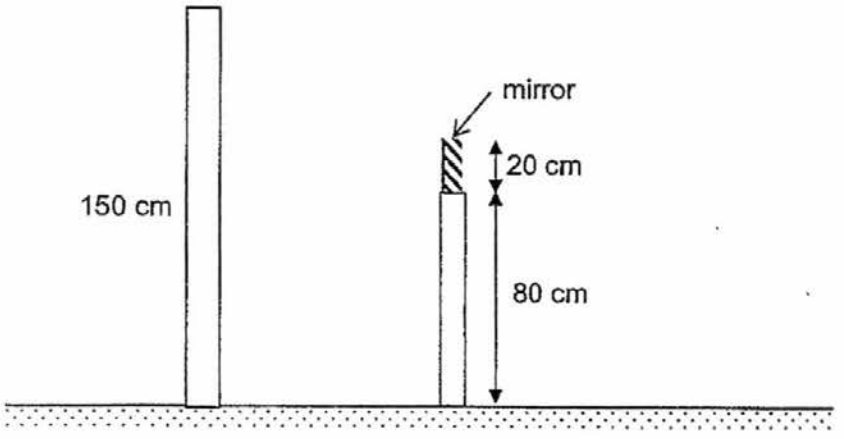


Which of the following best describes the processes that result from the blown air?

	rate of evaporation of ether	average energy of remaining molecules	temperature of ether
A	increases	increases	rises
B	decreases	increases	falls
C	increases	decreases	falls
D	decreases	decreases	rises

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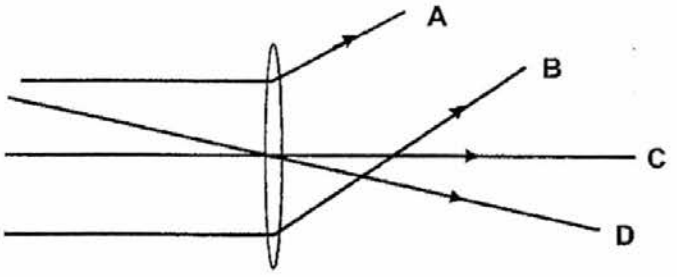
19 A 150 cm tall pillar stands in front of a 20 cm plane mirror which is 80 cm above the ground as shown in the figure.



How much of the image of the pillar could be seen through the mirror?

A 20 cm **B** 40 cm **C** 140 cm **D** 150 cm

20 The figure shows some light rays as they pass through a converging lens.



Which light ray is drawn wrongly?

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SECTION B : [50 marks]

Answer **ALL** *questions in this section. Show your working and write your answers in the space provided.*

1 **(a)** **Fig. 1.1** shows the reading of a pair of vernier calipers when its jaws are totally closed. **Fig. 1.2** shows the reading of the same pair of vernier calipers when it measures the diameter of a steel rod.

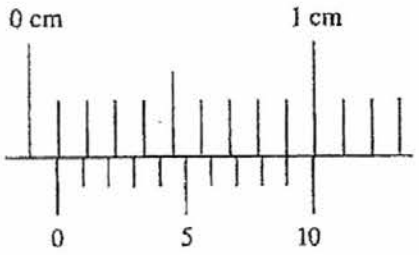


Fig. 1.1

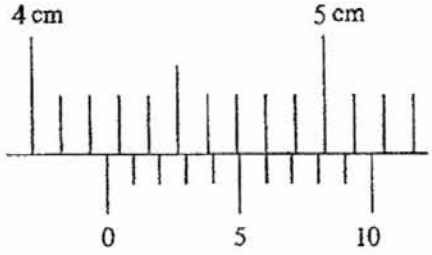


Fig. 1.2

(i) State the purpose of closing the jaws of the vernier calipers before measuring the diameter of the steel rod.

_____

_____ **[1]**

(ii) State the reading shown in **Fig. 1.1**.

reading = _____ **[1]**

(iii) What is the diameter of the steel rod?

diameter = _____ **[2]**

(b) State the effects (decreases, increases or unchanged) on the period of an oscillating pendulum in **Table 1.3**. **[3]**

Table 1.3

change made to the pendulum	effect on period
angle of oscillation increases	
length of pendulum decreases	
mass of bob decreases	

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2 A powerboat is used to pull a parascender at a constant speed and height.

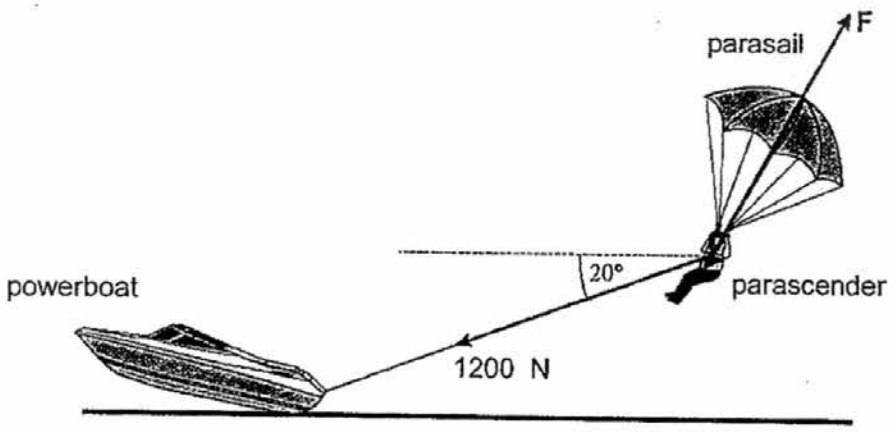


Fig. 2.1 (Diagram not drawn to scale)

The weight of the parascender is 900 N. A rope exerts a force of 1200 N on the parascender at an angle of 20° to the horizontal. Another force, **F**, is exerted on the parascender by the parasail.

(a) The resultant force acting on the parascender is 0 N.

(i) State what is meant by the *resultant of a number of forces.*

_____

_____ **[1]**

(ii) By scale drawing or otherwise, determine the magnitude and direction of, **F**, the force exerted on the parascender by the parasail.

magnitude of force = _____

202 direction of force = _____ **[4]**

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(b) The parascender releases the rope and initially rises higher.

Explain, in terms of the forces acting, why the parascender rises.

_____

_____

_____ [2]

3 While on Planet **X**, a goldsmith checks the purity of a small, uniform bar of gold by measuring its density.

The mass of the bar as 176.8 g and the weight of the bar as 1.80 N.

The dimensions of the bar are as shown on **Fig. 3.1**.

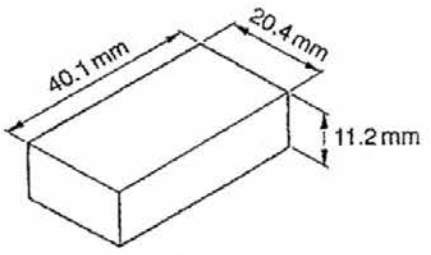


Fig. 3.1

(a) Define *gravitational field strength*.

_____ [1]

(b) Calculate the gravitational field strength of Planet **X**.

gravitational field strength = _____ [2]

(c) Calculate the density of the bar. Give your answer in g/cm^3.

density = _____ [3]

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(d) The density of pure gold is 19.281 g/cm^3. It is concluded that the bar is made of pure gold.
Suggest a reason for this conclusion to be valid.

_____

_____

_____ [1]

4 **Fig. 4.1** shows a system for raising a heavy piece of metal into a vertical position. A man pulls on the rope with a horizontal force ***T***. The piece of metal has a weight of 2000 N and is freely pivoted at **A**. The system is in equilibrium.

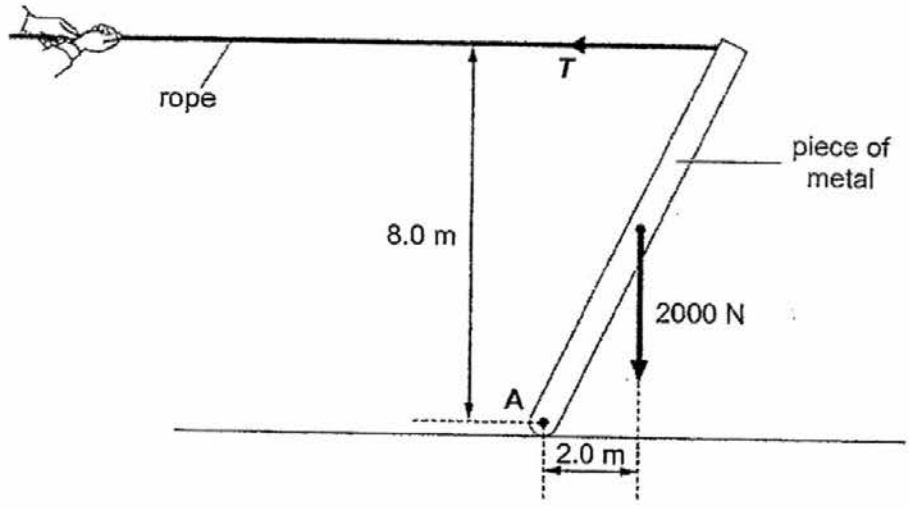


Fig. 4.1

(a) Explain what is meant by the *moment of a force*.

_____

_____ [1]

(b) By taking moments about **A**, calculate ***T***.

203

T = _____ [2]

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(c) The force ***T*** and the force that the rope exerts on the man are related by Newton's third law. State the relationship between these forces.

_____

_____

_____

_____ [2]

5 (a) Jen is helping her mother decorate her restaurant. She places two glass ornaments on a display shelf. One of the ornaments is empty while the other is filled with coloured glass marbles as shown in **Fig. 5.1**.



Fig. 5.1

State which ornament is more stable. Explain your answer.

_____

_____

_____

_____ [2]

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(b) A waiter in the restaurant places two wooden boxes filled with coffee beans standing on a counter top with a rough surface. The counter top is hinged so that it can be flipped open to allow servers to access the kitchen as shown in **Fig. 5.2**.

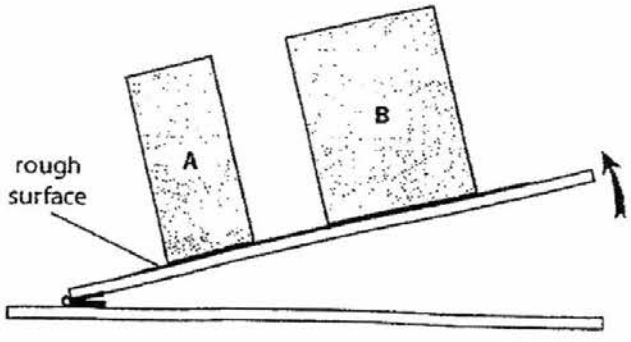


Fig. 5.2

When the counter top is slowly tilted, the boxes do not slip.
State which box falls over first and explain why.

_____

_____

_____

_____

_____ **[3]**

6 **Fig. 6.1** shows an illuminated smoke cell to demonstrate the Brownian motion of smoke particles.

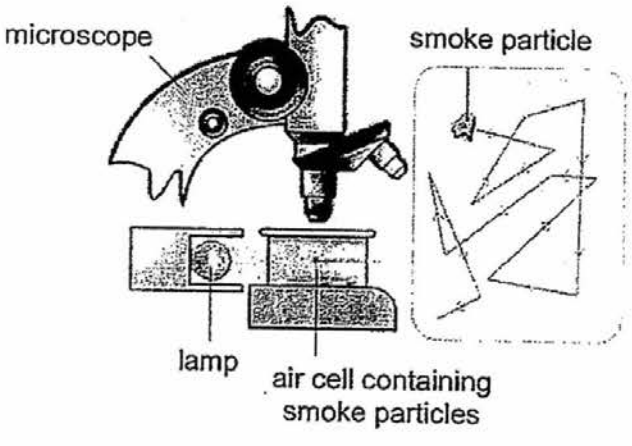


Fig. 6.1

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(a) State two reasons why collisions between air molecules and smoke particles result in the haphazard motion of the smoke particles.

_____

_____

_____

_____ [2]

(b) When the temperature of the air in the cell increases, the air molecules move faster. Explain why this increases the pressure of the air.

_____

_____

_____

_____ [2]

7 (a) The Celsius scale is commonly used in calibrating liquid-in-glass thermometers. Simple experimental procedures are often carried out to determine the ice point and steam point.

(i) Explain the term "ice point".

_____

_____ [1]

(ii) In determining the ice point, crushed ice are used during the experiment instead of ice cubes. Explain why this is so.

_____

_____ [1]

(b) Scientist uses thermocouple thermometers to measure the temperature of volcanic lava.

(i) State two advantages of a thermocouple thermometer other than the scientist being able to obtain indirect reading.

_____

_____

_____ [2]

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(ii) When one junction of a thermocouple is placed inside melting ice, and the second junction in steam, the millivoltmeter registers a reading of 24 mV. The reading changes to 40 mV when the second junction is placed inside the lava, with the first junction still inside melting ice.

Calculate the temperature of the lava.

temperature = _____ [2]

(iii) If another substance X is found to be 30 °C, calculate the reading that should be shown on the millivoltmeter.

reading = _____ [2]

8 A pot of water is heated on an electric stove, as shown in **Fig. 8.1**.

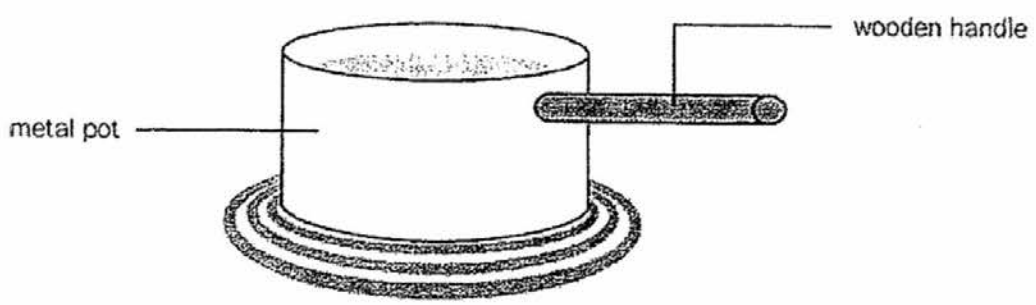


Fig. 8.1

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(a) Explain why the outer surface of the metal pot is often polished.

_____

_____

_____ [2]

(b) "Although both metal and wood are thermal conductors, metal is a much better conductor of thermal energy than wood."

Discuss this statement in terms of thermal energy transfer at the molecular level for both metal and wood conductors.

_____

_____

_____

_____

_____ [3]

(c) Describe the process of convection by which the water in the pot is heated.

_____

_____

_____ [2]

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SECTION C : [30 marks]

Each question is worth **10 marks.** *Answer* **ALL** *questions in this section.* **Question 3** *is an* **EITHER / OR QUESTION.** ***SELECT ONLY ONE PART OF THIS QUESTION.*** *Show your working and write your answers on the spaces provided.*

9 An experiment is set up to determine the relationship between the angle of elevation of a 2 m long ramp and the final speed achieved at **B** when a 20 kg block is released from rest at **A.** The efficiency of energy conversion from gravitational potential energy to kinetic energy is also determined.

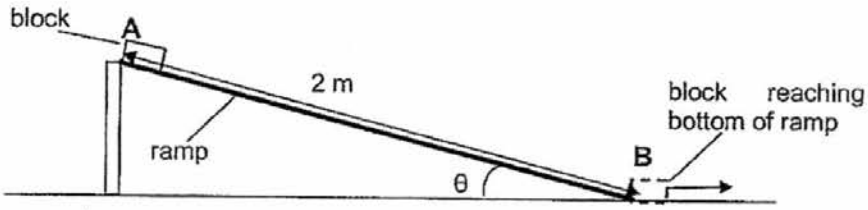


Fig. 9.1

θ / °	time t / s	average speed / m s^{-1}	final speed / m s^{-1}	GPE at **A** / J	KE at **B** / J	efficiency / %
20	1.61	1.24	2.48	137	62	45.3
30	1.11	1.80	3.60	200	**p**	65.0
40	0.90	2.22	**q**	257	197	76.7
50	0.79	2.53	5.06	306	256	**r**
60	0.72	2.78	5.56	346	309	89.3

Fig. 9.2

In this experiment, the raw data measured are the angle of elevation θ and the time taken t. The rest of the data are processed data.

(a) Explain how the average speed and final speed are determined.

_____

_____

_____

_____ **[2]**

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(b) Find the missing data in **Fig. 9.2**. Show your workings in the space provided below. Follow the precision of the data found in the same column.

p = _____

q = _____

r = _____ [4]

(c) The efficiency of the experiment is not 100 %. Suggest why the efficiency of the experiment is not 100 %.

_____

_____ [1]

(d) (i) Based on **Fig. 9.2**, what can be said about the Kinetic Energy at **B** as the angle of inclination, θ, increases?

_____ [1]

(ii) Explain why this is so even though the same ramp is used throughout the experiment?

_____

_____

_____ [2]

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10 **Fig. 10.1** shows an electric food steamer.

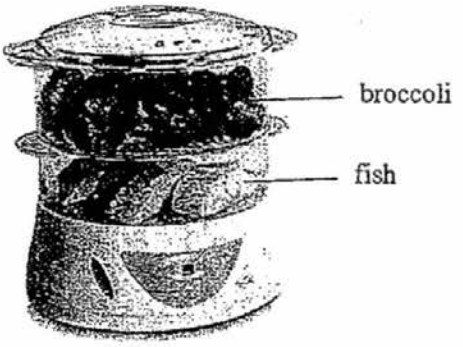


Fig. 10.1

To cook food, some water is placed in the lower compartment so that the steamer will heat the water automatically. The steamer changes the water to steam. Steam rises through the holes in the base of the food compartment and the food will be steamed.

(a) May poured 0.40 kg of water of 25 °C in the lower compartment of the steamer. Determine the amount of energy necessary to raise the temperature of the water from 25 °C to 100 °C.
(Specific heat capacity of water = 4200 J/kg°C)

amount of energy = _____ **[2]**

(b) Broccoli and fish need 600 kJ of energy to be steamed. Given that the power rating of the steamer is 800 W and that the specific latent heat of vaporisation is 2.3×10^6 J/kg, calculate

(i) the time required to steam the broccoli and fish after the water has reached 100 °C,

207 time taken = _____ **[2]**

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(ii) the mass of water that has been converted to steam during this period of time.

mass of water = _____ [2]

(c) Will the fish be cooked evenly? Explain.

_____

_____

_____

_____ [2]

(d) Do you think the food will cook faster if it is placed in boiling water instead of using the steaming method? Explain your answer.

_____

_____

_____

_____ [2]

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EITHER

11 **Fig. 11.1** shows a simplified brake mechanism that utilises a hydraulic system.

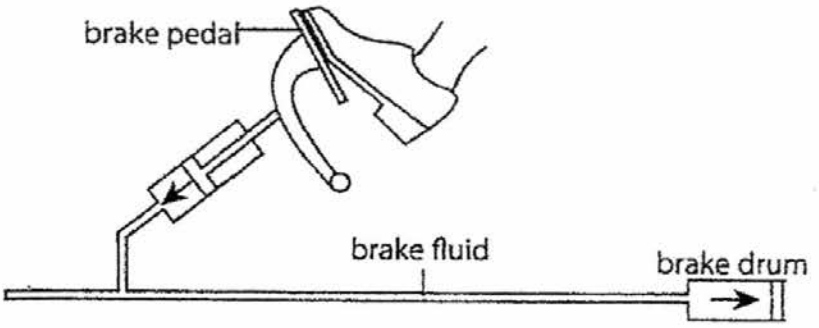


Fig. 11.1

(a) If a driver exerts a force of 50 N on the brake pedal, and given the ratio of the cross sectional area of the larger piston at the brake drum to the small piston located at the brake pedal is 24:1, calculate the force exerted on the brakes.

force = _____ **[1]**

(b) Explain why the presence of air bubbles in the brake fluid will cause the system to be inefficient.

_____

_____

_____

_____

_____ **[2]**

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(c) Atmospheric pressure can be measured using a simple mercury barometer.

Draw a labelled diagram of a simple mercury barometer. Explain clearly how the value of the atmospheric pressure is read from the barometer.

[3]

(d) State how the value of the atmospheric pressure is affected

(i) if the cross sectional area of the tube is increased.

[1]

(ii) if the barometer is taken to the bottom of a deep quarry below ground level. (Assumption: temperature remains constant)

[1]

(e) Using the concept of atmospheric pressure, explain how we are able to drink water from a cup using a straw.

[2]

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OR

11 (a) **Fig. 11.2** shows a simplified diagram of a **projector** used to project the slide **AB** onto a screen.

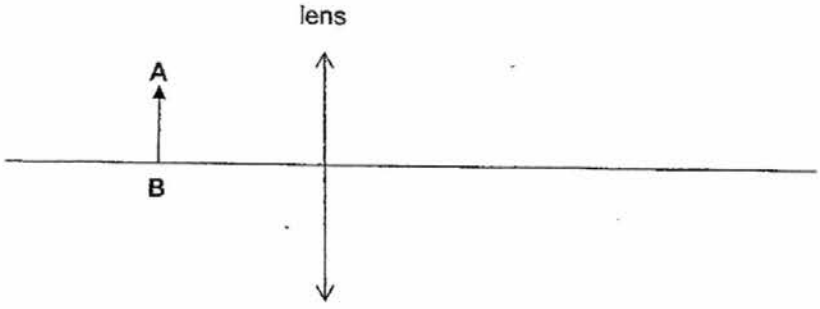


Fig. 11.2

(i) By using a suitable focal point, complete the ray diagram. Indicate the possible position of the image as **A'B'**. [3]

(ii) When the projector is turned on, the image is out of focus.

What can be done to bring the image into focus?

_____

_____ [1]

(b) **Fig 11.3** shows a small light source placed at the bottom of a 2 m deep swimming pool.

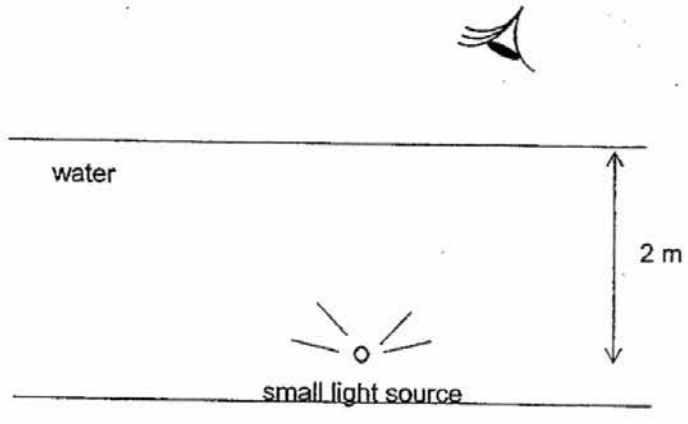


Fig. 11.3

The small light source emits light in all directions. However, due to total internal reflection, the light emitted forms only a circular spot on the water surface.

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(i) Explain what is *total internal reflection*.

_____

_____

_____ [2]

(ii) Given that the refractive index of water is 1.33, determine the critical angle of water.

critical angle = _____ [2]

(iii) Explain using the idea of total internal reflection, why a circular spot of light is formed instead of an illumination of the whole water surface.

_____

_____

_____

_____ [2]

END OF PAPER

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ST. PATRICK'S SCHOOL
END-OF-YEAR EXAMINATIONS 2016

SUBJECT	:	PHYSICS SPA 5059	DATE	:	10 OCT 2016
LEVEL	:	SECONDARY 3 EXPRESS	DURATION :		2 HRS

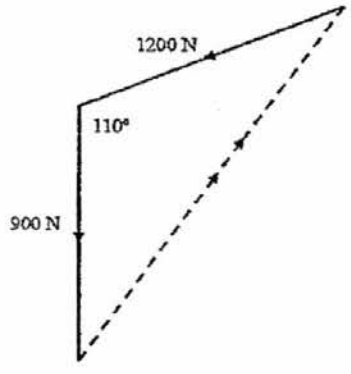
ANSWER SCHEME

SECTION A

1	2	3	4	5	6	7	8	9	10
D	C	C	A	A	C	B	C	D	D

11	12	13	14	15	16	17	18	19	20
A	B	D	C	A	B	D	C	B	A

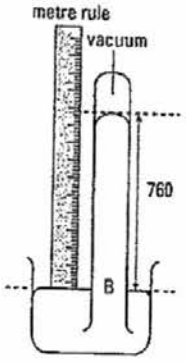
PAPER 2

					ttl
1	(a)	(i)	To check for any zero error.	1	7
		(ii)	0.09 cm	1	
		(iii)	4.26 – 0.09	1	
			= 4.17 cm	1	
	(b)	unchanged		1	
		decreases		1	
		unchanged		1	
2	(a)	(i)	A single force which will have the same effect as all the other forces.	1	7
		(ii)			
			Scale	1	
			Correct diagram	1	
			1730 ± 30N	1	
			41 ± 2° from vertical OR 49 ± 2° from horizontal	1	

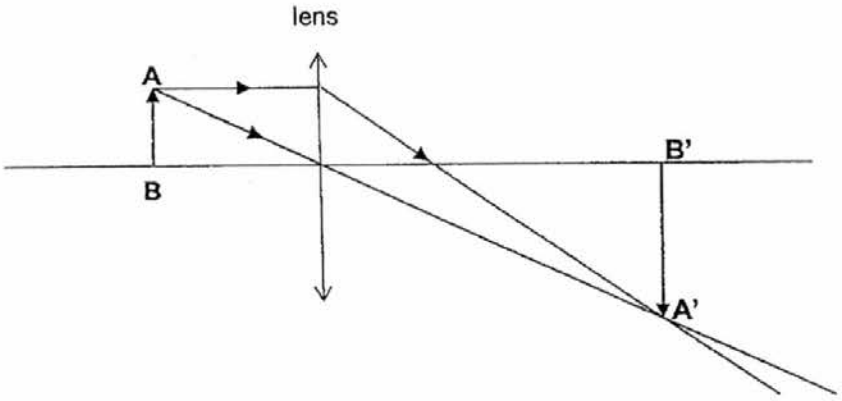
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	(b)	The upward force exceeds the weight Which results in an upward resultant force.		1 1	
3	(a)	Gravitational field strength is defined as gravitational force per unit mass.		1	7
	(b)	m = 176.8 g = 0.1768 kg W = mg 1.80 = 0.1768 x g g = 10.18 N/kg = 10.2 N/kg		 1 1	
	(c)	volume = 4.01 x 2.04 x 1.12 = 9.162048 cm^3 density = mass/volume = 176.8/9.162048 = 19.296995606222538890868067925425 = 19.3 g/cm^3		1 1 1	
	(d)	There could be error in the measurement of length of the gold bar and the dimensions used to calculate the density are only given to 3 significant figures and that some error is possible.		 1	
4	(a)	Moment of a force is the product of the force F and the perpendicular distance d from the pivot to the line of action of the force.		1	5
	(b)	T x 8.0 = 2000 x 2.0 T = 500 N		1 1	
	(c)	The forces are equal in magnitude, act in opposite direction on mutually opposite bodies.		1 1	
5	(a)	The empty glass The glass marbles in the glass has raised its centre of gravity, causing it to be less stable.		1 1	5
	(b)	Box A The line of action of the weight of box A will lie outside the base area first. Once the line of action of the force lies outside the base area, it results in an anti-clockwise moment about the pivot which topples the box.		1 1 1	
6	(a)	The air molecules are moving at random directions. Thus when they collide with the smoke particles from different directions, the resultant force will be random in magnitude and direction.		1 1	4
	(b)	The molecules hit the walls of the container more frequently. They also exert a larger force when they hit the walls.		1 1	
7	(a)	(i)	"Ice point" is the temperature which pure ice melts.	1	8
		(ii)	Crushed ice has a greater surface area which will enable the bulb of the thermometer to be fully covered with the ice.	 1	
	(b)	(i)	It can measure high temperature. It is sensitive to temperature change.	1 1	
		(ii)	40/24 x 100 = 167°C	1 1	
		(iii)	Θ/24 x 100 = 30 Θ = 7.2 V	1 1	
8	(a)	Polished surface is a poor emitter of radiation which this would minimise thermal energy loss to the surroundings by radiation.		1 1	7

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	(b)	In both metal and wood, molecules at the heated end will gain kinetic energy and vibrate more vigorously, colliding with the neighbouring molecules and transferring thermal energy. Metal has free electron which helps to transfer thermal energy faster.	1 1 1	
	(c)	Water nearer the bottom of the pot is heated, becomes less dense and rises to the top while water near the top of the pot is cooler is denser and sinks to the bottom. The difference in density sets up a convention current.	1 1	
9	(a)	Average speed = distance divided by time Average speed = (final speed – 0) ÷ 2	1 1	**10**
	(b)	v = 2.22 x 2 = 4.44 m/s KE = 0.5 x 20 x 3.6^2 = 130 J Efficiency = 256/306 x 100% = 83.7% All working shown	1 1 1	
	(c)	Some energy is used to do work against friction.	1	
	(d)	(i) K.E. increase as θ increases.	1	
		(ii) As θ increases, the vertical height of the point of release increases. This leads to the block possessing a higher G.P.E, resulting in a higher K.E. at the end of the ramp.	1 1	
10	(a)	Q = (0.40) (4200) (100-25) =126 000 J	1 1	**10**
	(b)	(i) 600 000 = 800t t = 750s	1 1	
		(ii) 600 000 = m (2.3 x 10^6) m = 0.26 kg	1 1	
	(c)	It will be evenly cooked as a convection current is set up in the compartment.	1 1	
	(d)	Food will cook faster using the steaming method. Steam has more energy than boiling water of the same mass.	1 1	
11	(a)	50 x 24 = 1200 N	1	**10**
	(b)	Air bubbles are compressible. Therefore the pressure transmitted to the brake drum will be lesser that the pressure applied by the pedal, hence the system will be inefficient.	1 1	
	(c)	 Diagram indication of vacuum P = density x g x height of mercury	1 1 1	

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	(d)	(i)	No change	1	
		(ii)	Increase	1	
	(e)	Suction causes the pressure at the mouth to decrease. Atmospheric pressure, which is higher will exert a force which pushes the water into the mouth.		1 1	
11	(a)	(i)	 Suitable focal point Correct ray diagram (with arrow) Image imverted and magnified	 1 1 1	**10**
		(ii)	Move the screen further or closer to the lens.	1	
	(b)	(i)	It is the reflection of light within the denser medium, when light travels from a denser medium to a less dense medium, such that the incident angle is larger than critical angle.	 1 1	
		(ii)	Sin c = 1/n c = sin-1 (1/1.33) c = 48.8°	 1 1	
		(iii)	The circular spot is formed when light emits at an angle of incidence smaller than the critical angle as light is refracted out of the water surface. Beyond the critical angle, light is reflected back into the water, resulting in no light emerging from the water surface.	 1 1	

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