E

GAN ENG SENG SCHOOL
End-of-Year Examination 2016

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PHYSICS (Sec 3 Express)

5059/01

Paper 1 Multiple Choice

10 October 2016
1 hour

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number on the OTAS.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

Read the instructions on the OTAS very carefully.

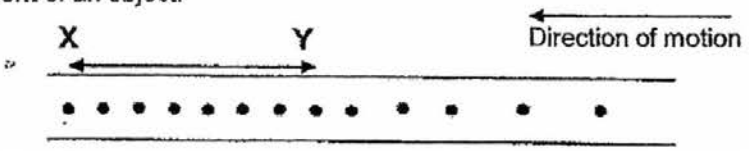
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

Total Marks
/40

1 Which of the following represents the longest length?

A 1.2×10^{-4} Mm
B 1.2×10^{3} km
C 1.2×10^{5} cm
D 1.2×10^{7} μm

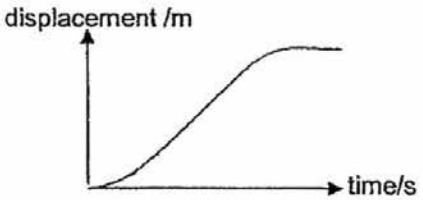
2 A ticker-timer, which puts 40 dots on a piece of paper tape per second, is used to investigate the movement of an object.



What is the length of time that corresponds to the distance between X and Y on the tape and the motion of the object?

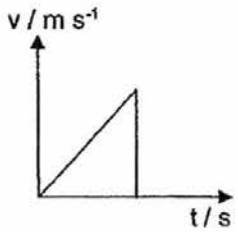
	Time	**Motion**
A	0.175 s	Increasing speed
B	0.175 s	Decreasing speed
C	0.200 s	Increasing speed
D	0.200 s	Decreasing speed

3 The graph below shows the displacement-time graph of a runner from a fixed point, along a straight track.

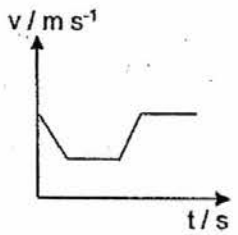


Which graph below represents the velocity of the same runner over the same period of time?

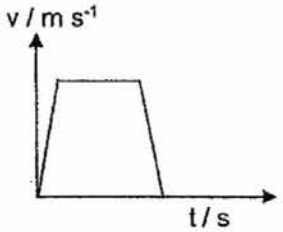
A



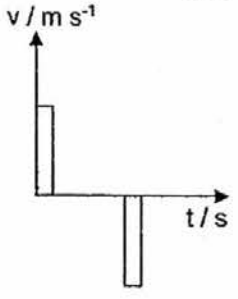
B



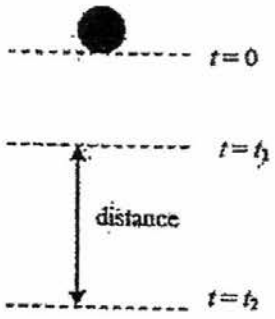
C



D



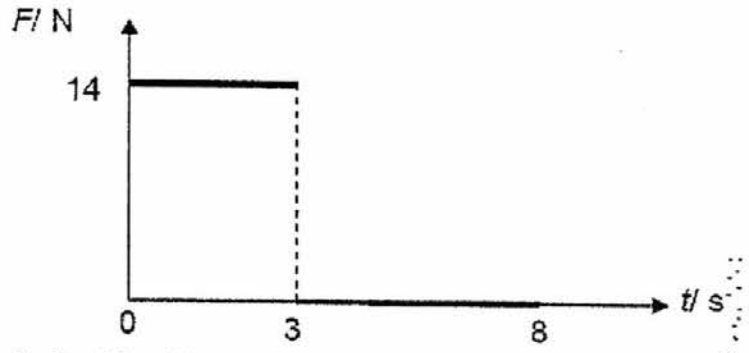
4 A ball is dropped vertically from rest at time $t = 0$ and accelerates downward with an acceleration g.



What distance does it travel between $t = t_1$ and $t = t_2$?

A $\frac{1}{2} g t_2^2$
B $\frac{1}{2} g(t_1 + t_2)$
C $\frac{1}{2} g(t_2 - t_1)^2$
D $\frac{1}{2} g(t_2^2 - t_1^2)$

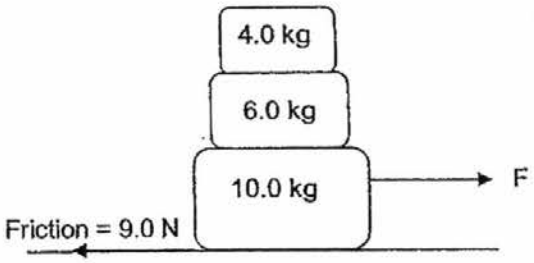
5 An object of mass 4 kg starts from rest and moves along a straight line on a rough horizontal surface. A force F acts on the object in its direction of motion. A graph of F against t is shown below. Assume constant friction of 2 N.



What is the velocity of the object at $t = 8$ s?

A 5.0 m/s
B 6.5 m/s
C 9.5 m/s
D 13.0 m/s

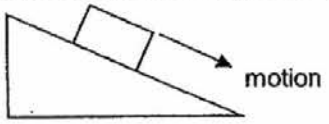
6 A replica of a wedding cake consists of three tiers stacked on top of one another. A student baker pulls the cake with a force F as shown. The bottom layer accelerates at 1.0 m/s^2.



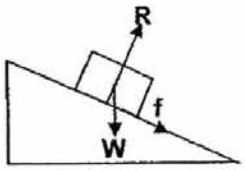
If the surfaces between each object are frictionless and the frictional force between the 10 kg layer and the floor is 9.0 N, which of the following statements is correct?

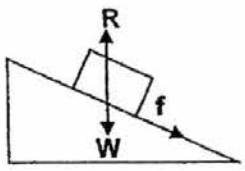
A The 4.0 kg and 6.0 kg layer also accelerate at 1.0 m/s^2
B The acceleration of the 6.0 kg layer will be larger than the 10 kg object as it has a smaller inertia.
C The force, F acting on the 10 kg layer is 19 N.
D The contact force between the 6.0 kg and 4.0 kg layer is 4.0 N

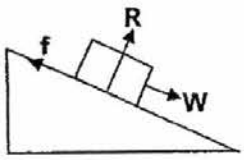
7 A block is allowed to slide down a rough inclined plane as shown in the diagram below. The forces acting on the block include normal reaction force R, its weight W and friction f.

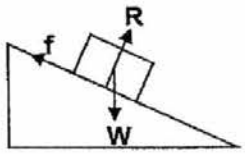


Which of the following diagrams shows all the forces acting on the block?

A


B


C


D


8 While on a mission on the moon, Low Jun hangs a 200 kg object freely and pushes it from the side. As compared to on earth, he feels that the object ..... .

A is easier to be pushed on the moon
B is more difficult to be pushed on the moon
C requires no effort to be pushed on the moon
D requires the same effort to be pushed as on the moon

9 The density of a liquid is 1.2×10^3 kg/m^3. If 1 cm^3 of the liquid changes to 600 cm^3 of vapour, the density of the vapour in kg/m^3 is.....

A $\frac{1.2}{600}$

B $\frac{1.2\times10^3}{600}$

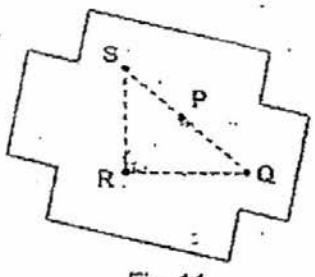
C 1.2×10^3

D $\frac{1.2\times10^3}{10^5}\times 600$

10 Which of the following objects has the greatest inertia?

A A 1 kg object moving at 30 m/s.
B A 5 kg object at rest.
C A 10 kg object moving at 2 m/s.
D A 15 kg object at rest.

11 A flat lamina has four points P, Q, R and S marked on it. When the lamina is freely suspended from P, Q is observed to be directly above P and S is directly below P. When it is freely suspended from R, S is observed to be directly below R. The weight of the lamina is 1.5 N.



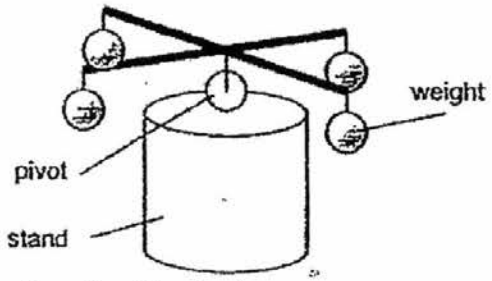
PQ = PS
QS = 0.500 m
RQ = 0.400 m

Fig. 11

With the lamina now suspended from P and displaced as shown in Fig. 11, what moment will cause the lamina to swing?

A 0.300 Nm anticlockwise
B 0.300 Nm clockwise
C 0.375 Nm anticlockwise
D 0.375 Nm clockwise

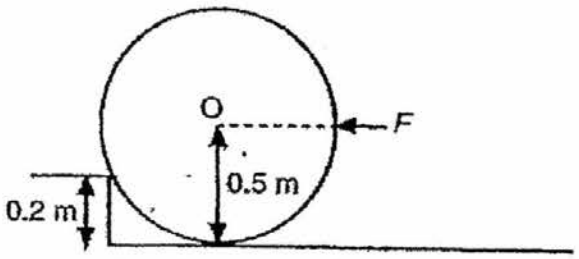
12 The diagram shows a balancing toy pivoted on a stand. If the toy is tilted slightly, it does not topple but returns to its original position.



This is because the centre of gravity of the toy is ..... .

A inside the weights
B exactly at the pivot
C directly below the pivot
D within the stand under the pivot

13 A uniform circular barrel of weight 1500 N and radius 0.5 m rests against a step of height 0.2 m as shown.



(Not drawn to scale)

What is the smallest horizontal force *F* though the centre O needed to push the barrel over the step?

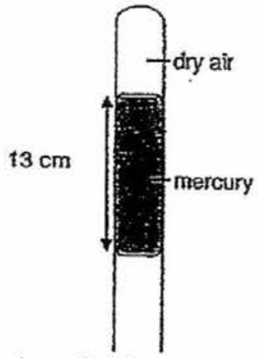
A 1125 N
B 1200 N
C 1875 N
D 2000 N

14 A manometer is used to measure the pressure of a gas. Which of the following factors would affect the reading?

I. The density of the liquid in the manometer
II. Cross-sectional area of the tube
III. Amount of liquid used.

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

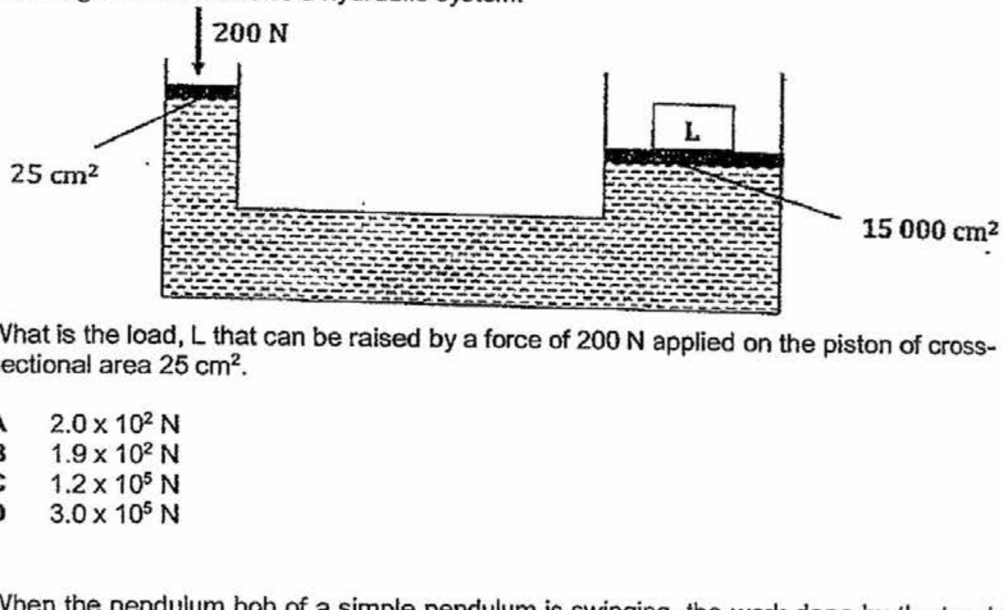
15 The diagram shows a column of dry air enclosed in a narrow capillary tube by a thread of mercury 13 cm in length.



What is the pressure of the dry air, given that the atmospheric pressure is 76 cm Hg?

A 13 cm Hg
B 63 cm Hg
C 76 cm Hg
D 89 cm Hg

16 The diagram below shows a hydraulic system.



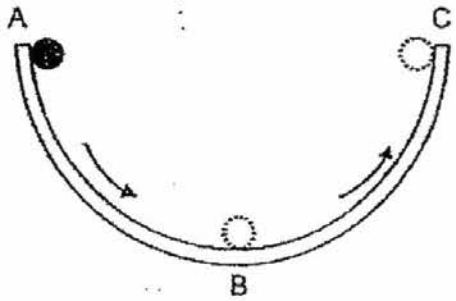
What is the load, L that can be raised by a force of 200 N applied on the piston of cross-sectional area 25 cm^2.

A 2.0×10^2 N
B 1.9×10^2 N
C 1.2×10^5 N
D 3.0×10^5 N

17 When the pendulum bob of a simple pendulum is swinging, the work done by the tension in the string on the bob is ....

A zero
B the gain in kinetic energy of the bob
C directly proportional to the length of the string
D depends on the swinging amplitude of the pendulum.

18 A ball of mass m is held at rest at one side of a frictionless curved track of height h.



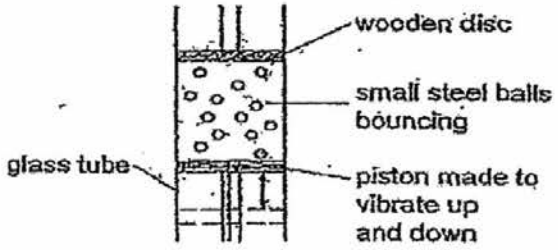
The ball is released and it rolls down the track from A to B and up to the other side of the track from B to C. Which of the expressions below represent the speed of the ball at the lowest point of the track?

A $(2gh)^2$
B $\sqrt{2gh}$
C $\sqrt{gh}$
D $\sqrt{mgh}$

19 A block of mass 3 kg is initially at rest on a frictionless, horizontal surface. The block is moved 8.0 m in 2.0 s by the application of a horizontal force 12 N. What is the average power developed while moving the block?

A 24 W
B 32 W
C 48 W
D 96 W

20 The following model is used to illustrate the behaviour of gas molecules. When the piston vibrates more rapidly, the wooden disc is forced further up the tube.



To cause the disc to return to its original position, weights are placed on the disc. This is similar to the situation when a gas is ..... .

A cooled then heated
B cooled then compressed
C heated then compressed
D heated then cooled

21 Marcus observes the Brownian motion of air mixed with smoke particles in a glass cell with a microscope and he sees moving points of light. These points of light come from ..... .

A air particles only moving randomly
B both smoke and air particles moving randomly
C smoke particles only moving randomly
D air movement in the glass cell.

22 A gas can be easily compressed because ..... .

A average molecular speeds are low
B intermolecular forces are very weak
C the molecules are elastic
D the molecules are very small

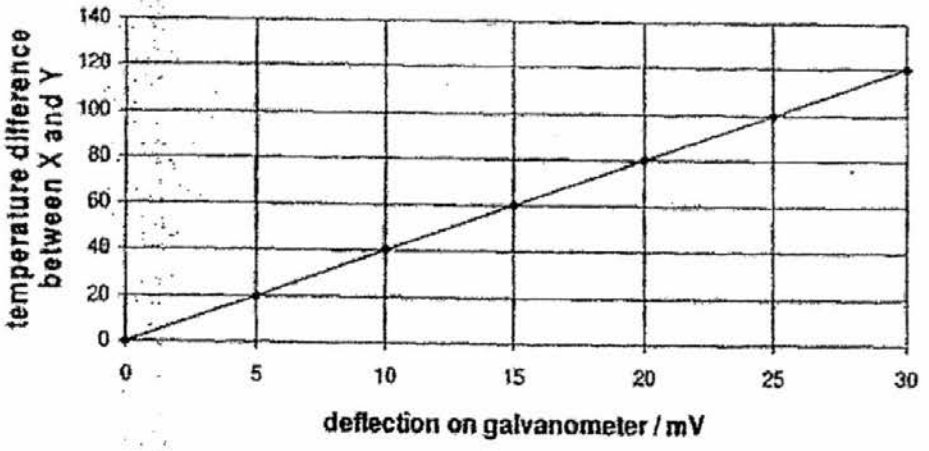
23 Which of the following temperatures is equivalent to 501 °C?

A - 228 K
B 228 K
C 774 K
D 775 K

24 The length of the alcohol thread in a thermometer is 3 cm at ice point and 5 cm at a temperature of 10 °C. What is the length of the alcohol thread when the thermometer is placed in pure boiling water?

A 23 cm
B 35 cm
C 46 cm
D 50 cm

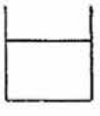
25 A thermocouple is constructed by putting two soldered ends (junctions) of two different metals into different temperatures. The galvanometer shows a deflection that depends on the temperature difference between the junctions X and Y.

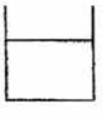


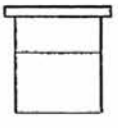
If X is placed in a substance of 20 °C and Y is placed in another substance of higher temperature, a deflection of 20 mV is seen, what is the temperature of Y?

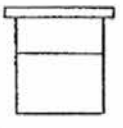
A 20 °C
B 80 °C
C 100 °C
D 120 °C

26 The diagram shows four similar cans. Each can contains the same volume of water initially at 80 °C. After five minutes, which can will contain the warmest water?

A dull black 

B polished silver 

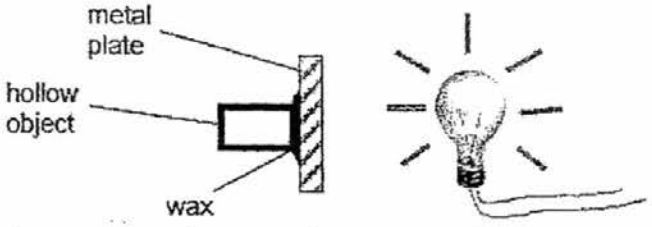
C dull black with lid 

D polished silver with lid 

27 Which of the following would not produce convection currents in a container filled with water at 30 °C?

A Dropping a piece of hot metal into the water
B Floating a piece of ice on water
C Lighting a candle beneath the container
D Placing a 100 W lit bulb above the water surface

28 A hollow object is stuck horizontally to a metal plate with wax. A 100 W filament light bulb is switched on and placed close to the metal plate. After a while, the wax melted and the object fell off.



Which of the following are correct heat transfer processes that took place?

A Convection and radiation
B Conduction and radiation
C Conduction and convection
D Conduction, convection and radiation

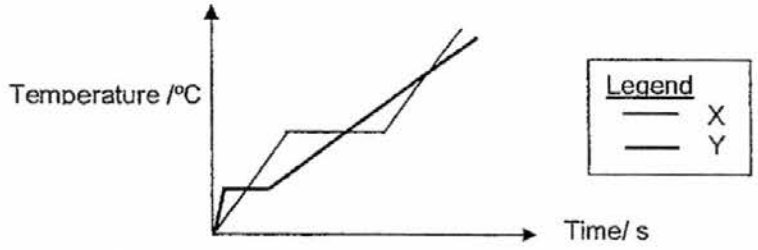
29 A lead bullet of mass 1 g at 30 °C is fired horizontally at a speed of 300 m/s into a large block of ice of temperature 0 °C, in which it is embedded. The bullet is then left to cool to 0 °C. How much ice is melted? [Specific heat capacity of lead = 128 J kg^{-1} $°C^{-1}$, specific latent heat of fusion of ice = 336 000 J kg^{-1}]

A 0.121 g
B 0.158 g
C 0.145 g
D 0.189 g

30 Pure water has a boiling point at 100 °C at 1 atmospheric pressure. Which of the following best explains the energy of water molecules at boiling point?

A The water molecules are gaining kinetic energy
B The water molecules are gaining potential energy
C The water molecules are gaining kinetic and potential energy
D The water molecules do not gain energy.

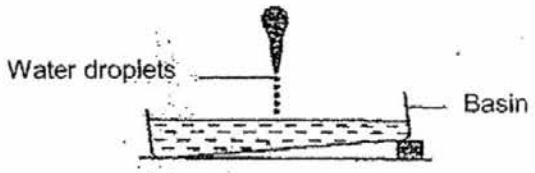
31 Equal masses of two solids X and Y are heated successively in a well-lagged calorimeter. Heat energy is supplied to each of them at the same rate. A temperature-time graph for the process is shown below.



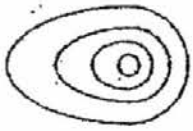
Which statement below is correct about X and Y?

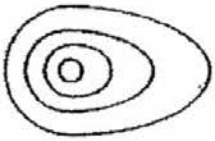
A Solids X and Y have the same specific latent heat of fusion.
B Solid Y has a higher melting point than solid X.
C Solids X and Y melt at the same temperature.
D Solid X has a lower specific heat capacity than solid Y.

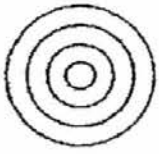
32 A tilted basin contains water. Water is dripped at a constant rate into the basin as shown in the diagram below.

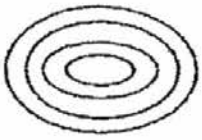


Which of the following patterns of the wavefronts will be observed in the basin?

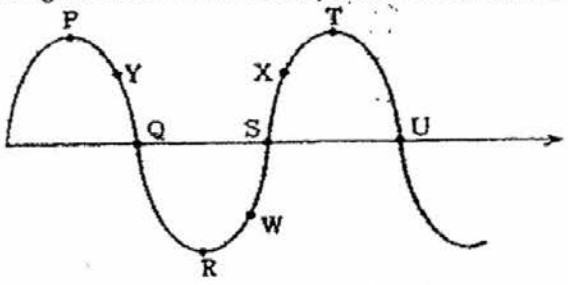
A 

B 

C 

D 

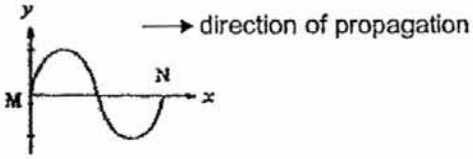
33 The figure below shows a snapshot of a transverse wave.



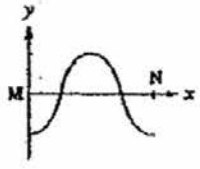
Which pair of points are in phase (moving in the same direction and having the same displacement from the rest position)?

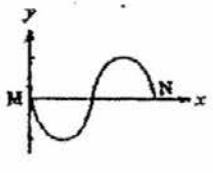
A P and R
B Q and U
C Y and W
D S and T

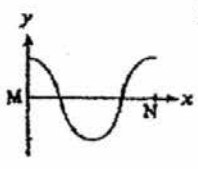
34 A wave is travelling along the positive x-axis. The diagram below shows part of the displacement-time graph at a certain instant.

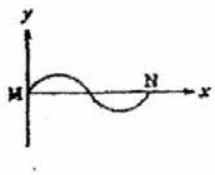


What is the shape of the wave between MN after one quarter of the period?

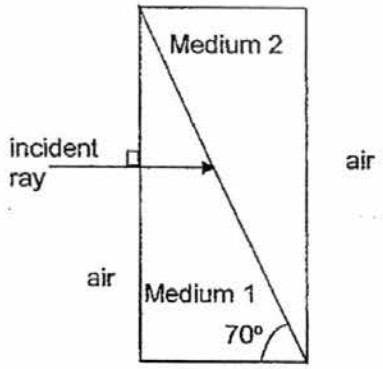
A 

B 

C 

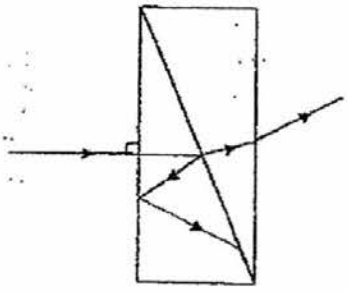
D 

35 Two prisms made from different glass are placed in perfect constant to form a rectangular block surrounded by air as shown. Medium 1 has a refractive index of 1.74 while medium 2 has a higher refractive index than medium 1.

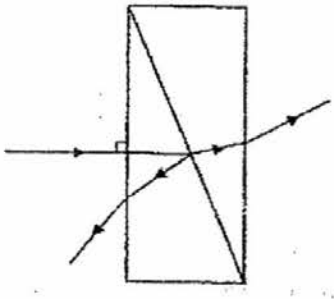


Which diagram below represents the path of the ray after it enters medium 1?

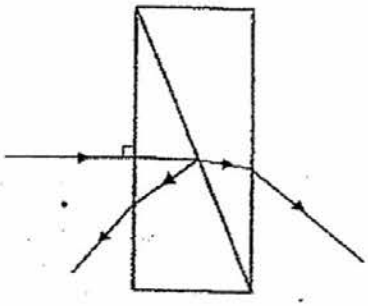
A



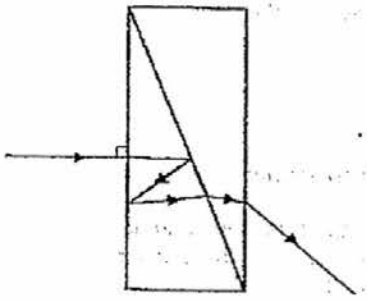
B



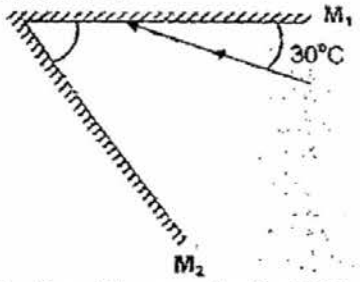
C



D



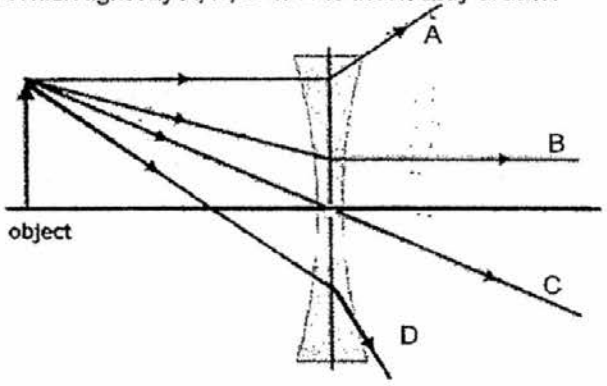
36 Two plane mirrors M_1 and M_2 make an angle of 60° with each other. A beam of light from a ray box is incident on mirror M_1 as shown.



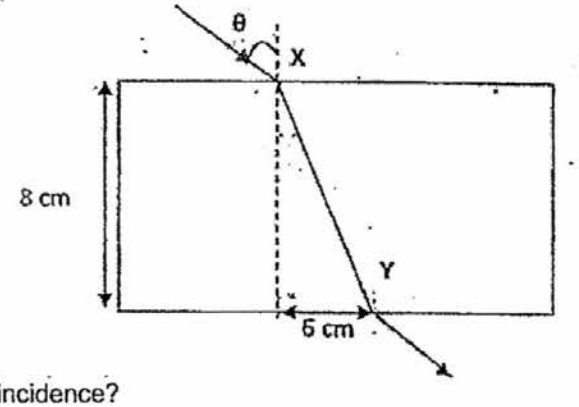
What would be the angle of reflection of the ray at mirror M_2?

A 0°
B 30°
C 60°
D 90°

37 In the diagram below, only three light rays from the object passing through the diverging lens are correctly drawn. Which light ray A, B, C or D is incorrectly drawn?



38 The diagram shows a light ray entering a glass block of refractive index 1.50 at X and emerging at Y.



What is the angle of incidence?

A 44.3°
B 64.2°
C 26.2°
D 71.3°

39 Waves P and W are components of the electromagnetic spectrum. P has a longer wavelength than Q. Which of the following statements is true about P and Q?

A Q has a lower frequency than P
B P can travel faster than Q in vacuum
C P is radiowave and Q is infrared
D Q is ultraviolet ray and P is X-ray

40 An X-ray scanner at an airport emits X-rays that have a frequency of 3×10^{17} Hz. What is the wavelength of these X-rays?

A 10 μm
B 1 μm
C 1 nm
D 10 nm

END OF PAPER

GAN ENG SENG SCHOOL
End-of-Year Examination 2016

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS (Sec 3 Express)
Paper 2 Theory

5059/02
12 October 2016
1 hour 45 minutes

Candidates answer on the Question Paper.
Calculators are allowed in the examination.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A
Answer all questions.

Section B
Answer all questions. Question 14 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	/50
Section B	/30
Total	/80

56

For Examiner's Use

Section A [50 marks]

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

1 Ari determines the thickness of a coin by taking a few readings at different positions of the coin with a micrometer screw gauge and finding the average. Fig. 1.1 shows one of those readings. Fig 1.2 shows the same micrometer screw gauge when it is fully closed.

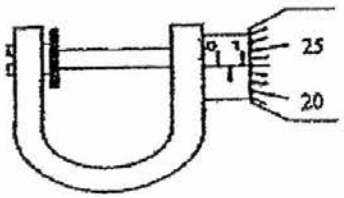


Fig. 1.1

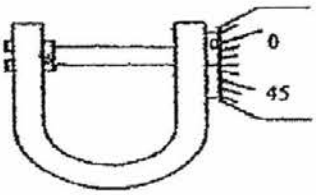


Fig. 1.2

(a) Determine the zero error on the micrometer screw gauge and thereafter, the actual thickness of the coin.

Zero error = ...[1]
Actual thickness = ...[1]

(b) Ari uses the thimble instead of the ratchet to turn the screw gauge during the experiment. What effect would this have on the accuracy of the thickness obtained?

.....

.....[1]

2 During a monsoon storm, a rock falls off a cliff from rest into soft mud beneath it. The rock, of weight 5 N, takes 2 s to fall before it embeds itself 20 cm into the mud. Assume air resistance is negligible.

(a) Calculate the height of the cliff.

Height = ...[2]

For Examiner's Use

2 **(b)** Calculate the time taken of the rock between hitting the mud and coming to rest inside it.

Time taken = ...[2]

(c) Calculate the average acceleration of the rock in the soft mud.

Average acceleration = ...[2]

3 Two beginner figure skaters, Alice and Bob stand at rest on a smooth ice rink where there is negligible friction. They hold on to each other for support when a force of 200 N is exerted on them by a third person. The figure skaters move with an acceleration of 1.6 m/s^2. The mass of Alice is 50 kg.

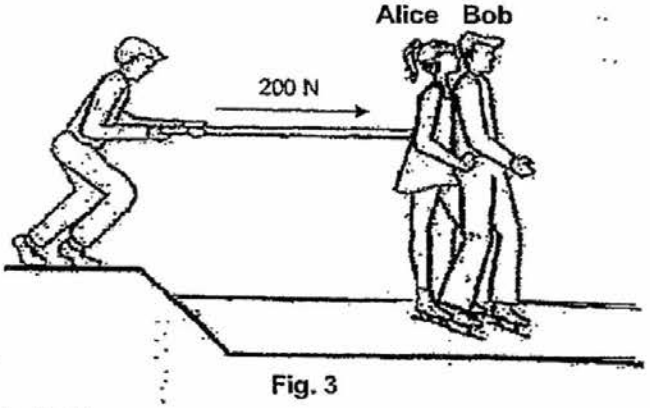


Fig. 3

(a) Calculate Bob's mass.

Mass = ...[3]

(b) Calculate the force of Alice on Bob.

Force of Alice on Bob = ...[1]

For Examiner's Use

4 Fig 4 shows James swimming at 2 m/s relative to the water in a river. He sets out 50 ° to the bank of the river and is carried downstream as he swims since the river flows at 1.5 m/s.

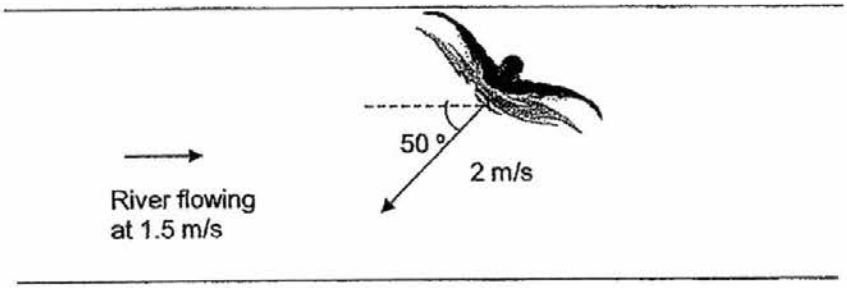


Fig. 4

Using the graphical method of a vector diagram, find the magnitude and direction of his resultant velocity.

Magnitude = ...
Direction = ...[4]

For Examiner's Use

5 An alloy is made of 65 % iron and 35 % copper by volume. It is used as a spare part in the International Space Station (ISS). The density of copper and iron is 8.90 g/cm^3 and 6.98 g/cm^3 respectively.

(a) Determine the density of 100 cm^3 of the alloy.

Density = ...[2]

(b) State and explain what change would occur in the value of **(a)** if the spare part was reduced to half its size and brought from Earth to the ISS. Assume temperature remains constant.

.....

.....

.....[2]

6 Fig. 6 shows a paper weight that has been displaced and is stationary in its new displaced position. The centre of gravity of the paper weight is clearly shown.

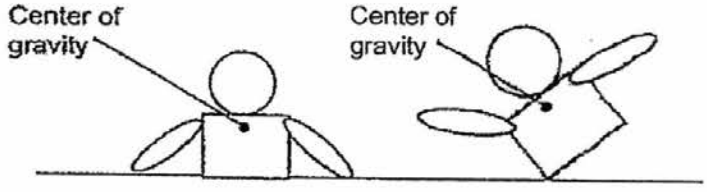


Fig. 6

(a) State and explain the type of equilibrium the paper weight is in after it is displaced.

.....

.....

.....[2]

(b) If this paper weight is freely suspended, explain the position of its centre of gravity.

.....

.....

.....[2]

For Examiner's Use

7 Fig 7 shows a diver snorkelling in the sea. In an attempt to do deep sea snorkelling, he has extended the length of his snorkel tube. The density of water is 1024 kg/m^3 and the atmospheric pressure at sea level is 1.0×10^5 Pa.

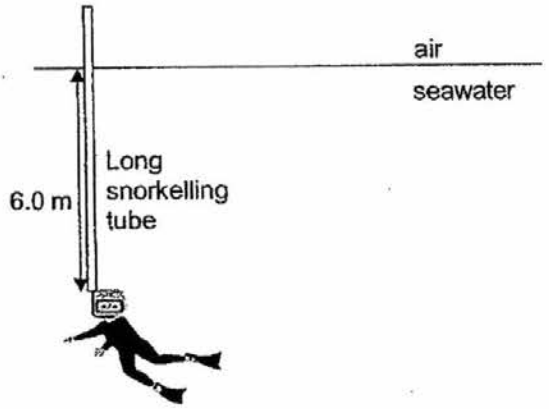


Fig. 7

(a) Calculate the pressure acting on the diver when he is 6.0 m under water.

Pressure = ...[2]

(b) The human lungs can withstand a pressure difference of up to one-twentieth of atmospheric pressure. Calculate how far the diver can swim below the surface of the sea by breathing through the snorkel tube.

Distance under the sea = ...[2]

(c) Explain what will happen to the diver when he breathes through the snorkel tube when he is 6.0 m below the surface of the sea.

.....

.....[1]

For Examiner's Use

8 Nicky investigates the principle of conservation of energy by using the pendulum experiment. He releases the pendulum from a certain height h, as shown in Fig. 8.1, and measures the speed of the pendulum bob during the oscillation.

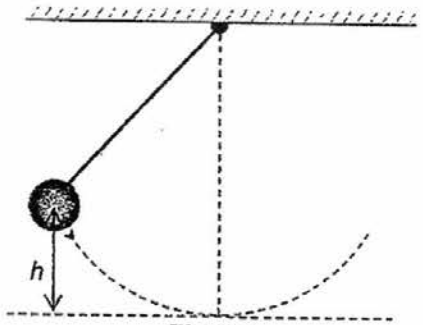


Fig. 8.1

Fig. 8.2 shows how the speed of pendulum bob varies with time in the first 2.0 s.

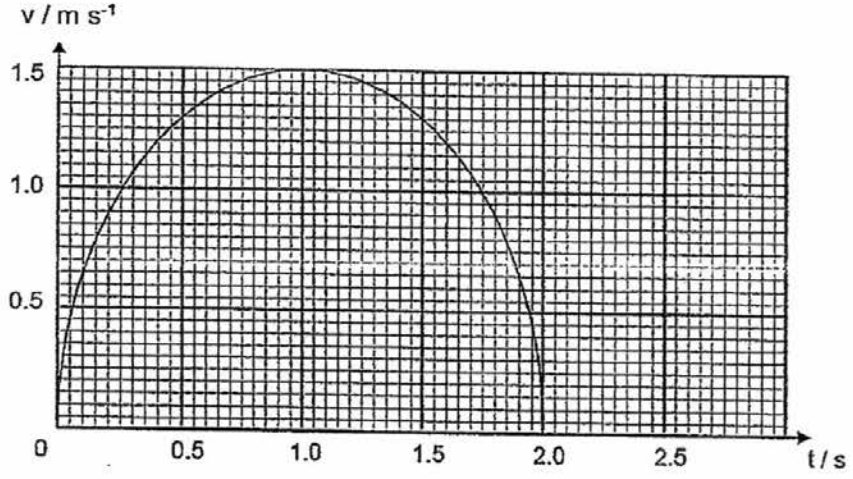


Fig. 8.2

(a) State the principle of conservation of energy.

.....

.....[1]

(b) Determine the period of oscillation of this pendulum.

Period of oscillation = ...[1]

For Examiner's Use

8 (c) Calculate the height, h, from which the pendulum is released.

h = ...[2]

9 Fig. 9 shows Luqman attempting underwater photography in a swimming pool. When he takes a photo with flash, there is a circle of light formed on the water's surface as shown in the diagram. Assume that the camera flash is a point source of light represented by point **P** and that the camera is at a depth of 0.525 m. Take the refractive index of water to be 1.33.

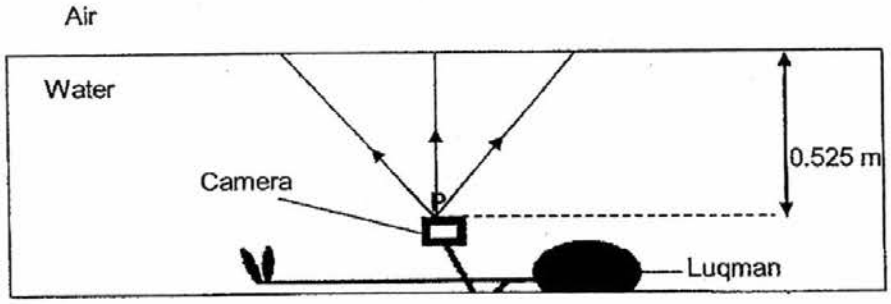


Fig. 9

(a) On Fig. 9, two of the light rays are incident on the water at the critical angle. Continue the rays of light and label the critical angles **C** on Fig. 9. [2]

(b) Calculate the radius of the circle of light formed on the water surface.

Radius = ...[2]

For Examiner's Use

9 (c) In order to continue his pool photography more comfortably, Luqman wants to increase the temperature of the pool water. Explain where he should put the heater.

.....

.....

.....

.....[2]

10 A small, very brightly illuminated display is located at the back of a projector. The projector lens produces an inverted and magnified image of the display on a white classroom wall. Fig. 10 is a scale diagram showing the position and size of both the display and the image on the wall.

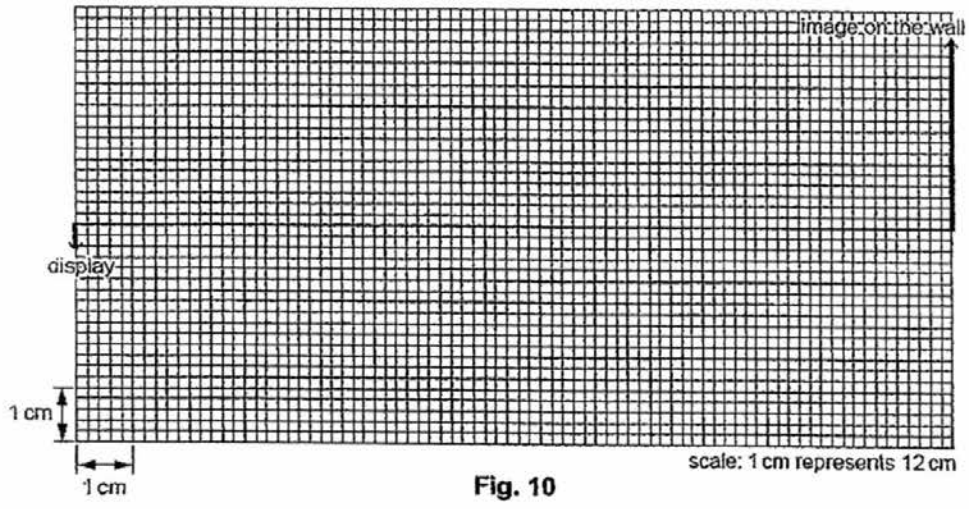


Fig. 10

On Fig. 10, determine the focal length of the lens.

Focal length = ...[4]

For Examiner's Use

11 (a) Fig. 11 shows some oil in a ripple tank that has shallow and deep sections. A machine in the shallow section generates 1800 waves per minute. The waves in the shallow section move towards the deep section in the direction shown.

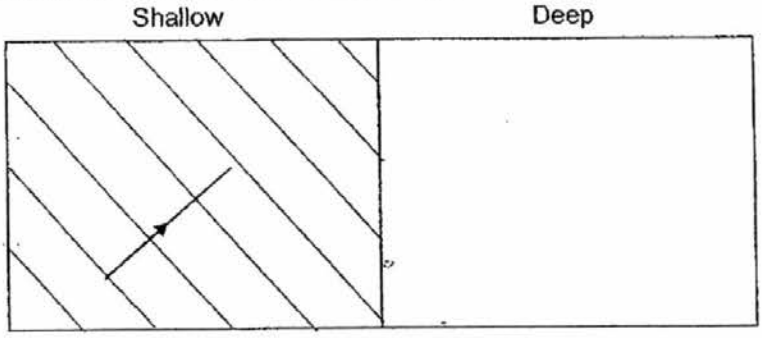


Fig. 11

There is a distance of 0.70 m between the wave crests in the shallow section.

(i) Calculate the velocity of the waves in the shallow section.

Velocity = ...[2]

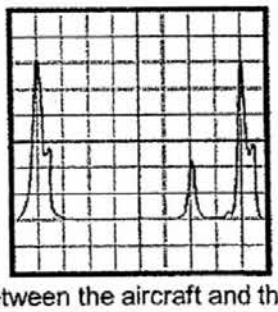
(ii) State what happens to the wavelength of the wave in the deep section.

.....

.....[1]

(iii) On Fig. 11, draw the wavefronts and indicate the direction of the wave in the deep section. [1]

(b) A radar station detects an aircraft flying near it using electromagnetic waves. The radar station sends a pulse of the electromagnetic wave every 40 μs. The pulses are reflected from the aircraft back to the station. These signals are displayed on the screen of a Cathode Ray Oscilloscope.



Estimate the distance between the aircraft and the station.

Distance = ...[2]

For Examiner's Use

Section B [30 marks]

Answer **all** the questions in this section.

Answer only one of the two alternative questions in **Question 14.**

12 Each year, American families celebrate Thanksgiving Day with a traditional feast that includes a roasted turkey. A turkey is well cooked when it reaches an internal temperature of 85 °C. A pop-up turkey timer thermometer is used to indicate that the turkey in an oven is cooked. The turkey timer is inserted into the thickest part of the turkey breast, avoiding bone and fat. When the required temperature has been reached, the turkey timer pops up. Fig.12 shows a pop-up turkey timer thermometer before cooking and after it has popped up.

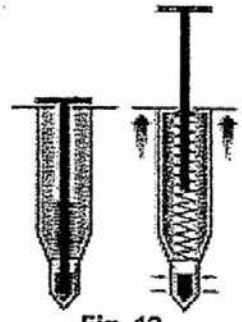


Fig. 12

The turkey timer is made of a stick with a spring in a case held into place by a soft metal in the tip of the casing. The metal is solid at room temperature and melts at 85 °C. When the metal melts, it frees the end of the stick that had been trapped in the metal. The elastic potential energy from the spring turns into kinetic energy which pushes the stick up. Assume room temperature as 25 °C.

(a) State and explain the process in which the heat is transferred from the turkey to the turkey timer.

.....

.....

.....

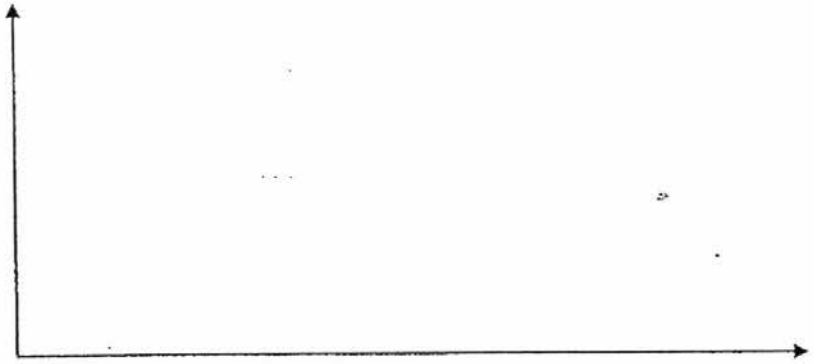
.....[2]

(b) The turkey cooks for 4 hours in a 4.4 kW oven. Given that the specific heat capacity of the metal is 0.13 kJ/kg/°C and its mass is 150 g, calculate the specific latent heat of fusion of the metal in the turkey timer.

Latent heat of fusion = ...[3]

For Examiner's Use

12 (c) On the axes below, sketch the heating curve of the metal in the turkey timer from the time the oven is started to the time the metal melts. Label the axes accordingly.



[2]

(d) Explain why there is no change in kinetic energy of the metal particles when it changes from solid to liquid at 85 °C.

.....

.....

.....

.....[2]

(e) A turkey timer is reusable for up to 200 times. Suggest a method to return the stick to its original position after it has been used.

.....

.....[1]

For Examiner's Use

13 A small boat is powered by an outboard motor of variable power output P. Fig. 13.1 shows the variation with speed P when the boat carries different loads.

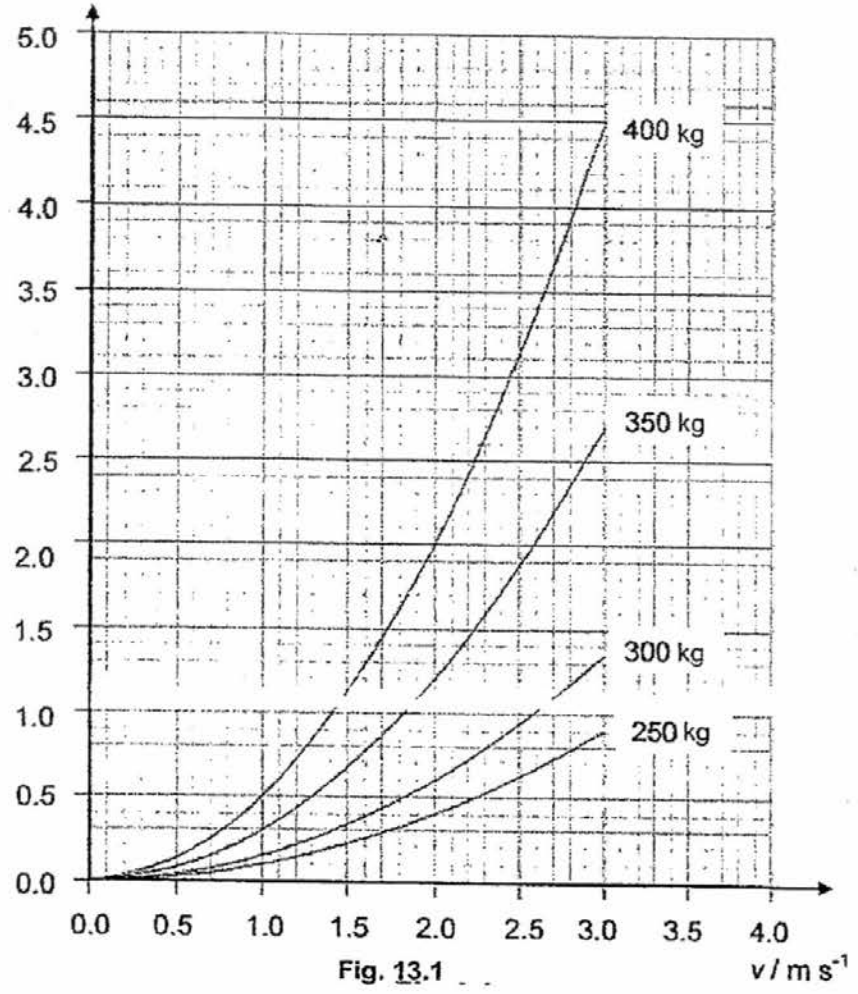


Fig. 13.1

The masses shown are the total mass of the boat plus passengers.

(a) For the boat having a steady speed of 2.00 m/s and a total mass of 250 kg, determine the power of the engine and the resistive force acting on the boat.

Power of the engine = ...[1]

Resistive Force on the boat = ...[2]

62

For Examiner's Use

13 (b) The boat of mass 350 kg moves with a speed of 2.50 m/s.

(i) Estimate the total energy that the motor provides for the boat to travel for 30 minutes.

Total energy = ...[2]

(ii) The amount of energy given off when 1.00 kg of fuel is mixed with oxygen in the air is 45.0 MJ. The efficiency of the motor in converting the energy released with the combination of oxygen and the fuel is 40.0 %. Determine the total amount of fuel that would be expended.

Total fuel expended = ...[2]

(c) Fig. 13.2 shows how the speeds of 2 boats of equal mass vary with respect to time. Boat A starts from rest while boat B travels at constant speed.

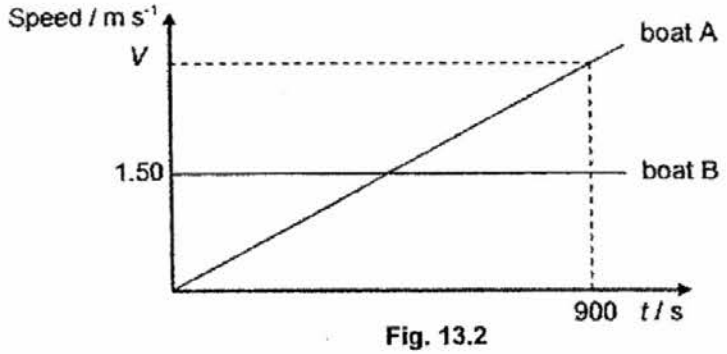


Fig. 13.2

(i) Both Boat A and B travel the same distance at $t = 900$ s. Calculate the velocity, V at $t = 900$ s.

Velocity, V = ...[1]

(ii) Which boat requires more petrol? Why?

.....

.....

.....[2]

For Examiner's Use

EITHER

14 (a) Fig 14.1 shows a pump.

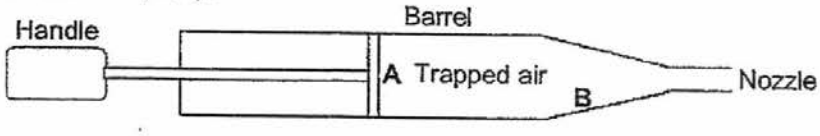


Fig. 14.1

When the nozzle is blocked and the handle is slowly pushed in so that the temperature of the air in the barrel remains constant, the pressure of the air rises.

(i) Explain, in terms of the molecular motion, whether trapped air creates a smaller, larger or same pressure on face A compared to face B of the pump.

.....

.....

.....

.....[2]

(ii) Explain why the pressure increases when the handle is slowly pushed in. State one assumption in your explanation.

.....

.....

.....

.....[2]

For Examiner's Use

14 (a) (iii) The cross-sectional area of the barrel is 1000 mm^2. The pump handle is pushed in until the trapped air is at a pressure that corresponds to the U - shaped tube containing water as shown in Fig.14.2.

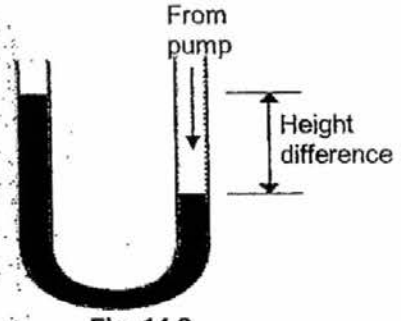


Fig. 14.2

The difference in water levels is 20.0 cm. Assume atmospheric pressure is 10 m water. Calculate the force applied to the handle.

Force = ...[3]

(b) The difference in water levels was measured at different temperatures and the readings are tabulated.

Temperature θ/°C	30	40	50	60
Difference in water levels/ cm	20.0	25.0	35.0	50.0

(i) Using kinetic theory of matter, explain why the difference in water levels increases when temperature increases.

.....

.....[1]

(ii) If the apparatus is used to construct a thermometer where the difference in water level is related to the temperature of the environment, suggest two limitations of this thermometer.

.....

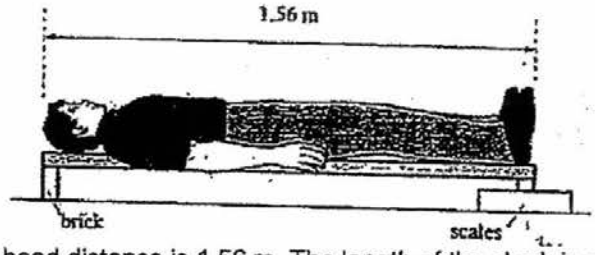
.....

.....[2]

For Examiner's Use

OR

14 Bryant conducts an experiment to find the centre of gravity of a person. He lies flat on a uniform plank of mass 15 kg. The plank, with Bryant on it, is placed on a brick and some bathroom scales as shown in the diagram below.



Bryant's toe-to-head distance is 1.56 m. The length of the plank is also 1.56 m. Bryant's mass is 62 kg.

(a) Identify and label all the forces acting on the system. [3]

(b) The reading on the bathroom scales is 30 kg. Use this information to determine how far Bryant's centre of gravity is from his toes.

Distance of centre of gravity from toes = ...[3]

(c) Bryant then gets up to sit in an upright position on the plank with his feet still aligned to the scales. Explain how the reading on the scale would change.

.....

.....

.....[2]

(d) If the brick is replaced by another bathroom scale, find the reading on the scale.

Reading on the scale = ...[2]

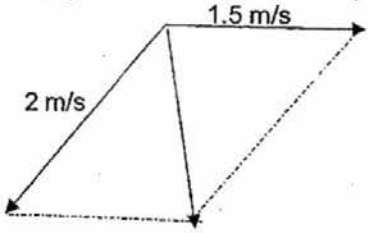
END OF PAPER

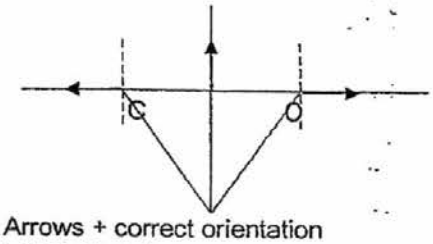
2016 Sec 3Ex Pure Phy 5059 EOY Marking Scheme

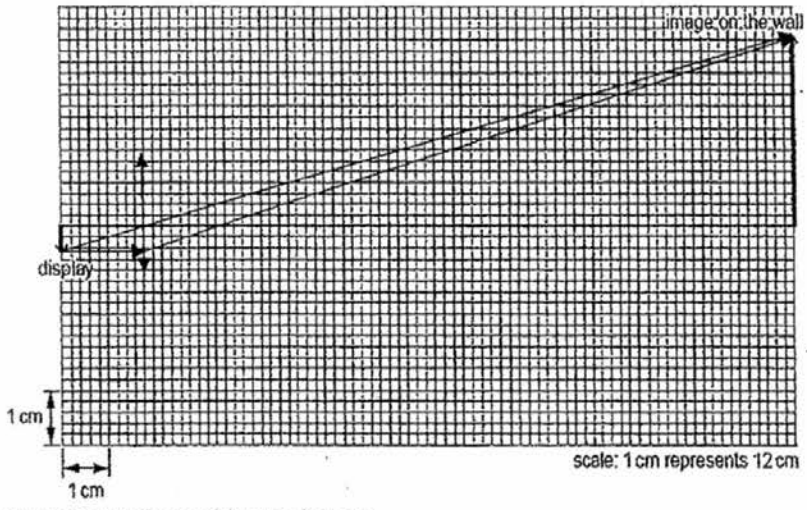
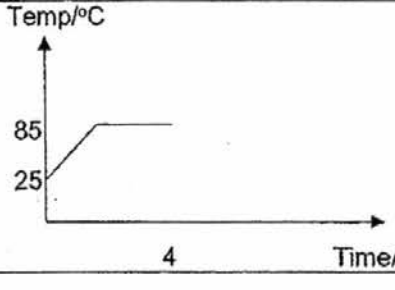
No	Answer	Notes
1	B	
2	A	
3	C	
4	D	
5	B	
6	C	
7	D	
8	D	
9	B	
10	D	
11	A	
12	D	
13	D	
14	A	
15	B	
16	C	
17	A	
18	B	
19	C	
20	C	
21	C	
22	B	
23	C	
24	A	
25	C	
26	D	
27	D	
28	B	
29	C	
30	B	
31	D	
32	A	
33	B	
34	A	
35	A	
36	A	
37	B	
38	B	
39	C	
40	C	

Paper 2

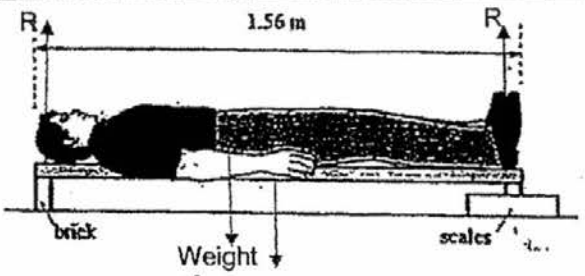
No	Answer	Marks
1a	Zero error = - 0.03 mm Actual thickness = 1.23 – (-0.03) = 1.26 mm	1 1
1b	Inaccurate as inconsistent force used to tighten the micrometer screw gauge / Smaller reading obtained due to over-tightening	1

2a	Height = ½ x 2 x (final velocity) h = ½ x 2 x v a = (v-u)/t 10 = (v)/2 v = 20 m/s h = ½ x 2 x 20 = 20 m	1 1
2b	S = 0.5 vt 0.20 = 0.5 (20) t t = 0.020 s	1 1
2c	a = (v-u)/t = -20/0.020 = -1000 m/s^2	1 1
3a	F = ma m = 200 /1.6 = 125 kg Mass of B = 125 – 50 = 75 kg	 1 1 1
3b	F = 75 x 1.6 = 120 N	 1
4	Scale 1 cm : 0.5 m/s (or any appropriate scale) Correct diagram with correct arrows (labelled angles etc)  Magnitude = 1.56 m/s (1.46 – 1.66 m/s) Direction : 81° w. r to 1.5 m/s (+/- 2 degrees)	1 1 1 1
5a	65 cm^3 of Iron : m_{iron} = 6.98 x 65 = 453.7 g 35 cm^3 of Copper : m_{copper} = 8.90 x 35 = 311.5 g Density = (453.7 + 311.5) / 100 = 7.65 g/cm^3 or 7650 kg/m^3	1 1
5b	There would be no change in the density Density of a material is fixed	1 1
6a	Unstable equilibrium. The centre of gravity has been raised, but the line of action of the weight lies directly on the pivot, hence there is no net moment.	1 1
6b	When the centre of gravity is not directly under the point of suspension, its weight will produce a moment about the point of suspension, causing the object to oscillate. The object comes to rest when the centre of gravity of the object is directly below the point of suspension. The line of action of the weight passes through the pivot and hence there is no net moment.	1 1

7a	Pressure = Patm + Pwater = $1.0 \times 10^5 + 6(1024)(10)$ = 1.61×10^5 Pa	1 1
7b	Pressure difference = $1/20 \times (1.0 \times 10^5)$ = 5000 Pa P = hpg $5000 = h \times 1024 \times 10$ h = 0.488 m	 1 1
7c	The diver will have difficulty breathing as the pressure difference between his lungs and the external environment is much greater.	1
8a	Energy cannot be created or destroyed, but can be changed from one form to another.	1
8b	Period = 2 x 2 = 4 s	1
8c	GPE lost = KE gained $Mgh = \frac{1}{2} mv^2$ $h = \frac{1}{2} (1.5)^2 / 10$ = 0.113 m	 1 1
9a	 Arrows + correct orientation Label of angles.	 1 1
9b	Critical angle = $\sin^{-1}(1/n)$ = $\sin^{-1}(1/1.33)$ = 48.75 ° Radius of circle of light = 0.525 tan 48.75 = 0.598 m (accept 0.599 m)	 1 1
9c	Heater should be at the bottom of the pool. The hot water will expand, and since less dense, will rise. The denser cool water will sink to take its place and the cycle will repeat, creating a convection current.	1 1

10	 Straight ray from object to image Vertical line labelled L where first ray intersects principal axis Second ray drawn from arrowhead of object to lens (parallel to principal axis) and straight to arrowhead of image. Focal length = 1.8 x 12 = 21.6 cm (19 – 23 cm)	 1 1 1 1
11ai	Velocity = frequency x wavelength = 1800/60 x 0.70 = 21.0 m/s	1 1
11aii	Wavelength increases in the deep section.	1
11aiii	Wavelengths wider with correct direction indicated by arrow Refracted wavefronts drawn from incident at the boundary, perpendicular to direction of refracted wave motion.	1 1
11b	Each division = 40μs/8 = 5 μs Speed = 2d/t $3 \times 10^8 = 2d/(6x5\ \mu s)$ d = 4500 m	 1 1
12a	Conduction Since the timer and the turkey are in contact, thermal energy is transferred to the case of the timer and the soft metal therein. The free electrons and metal atoms have an increased vibrational kinetic energy and collide with adjacent atoms.	1 1
12b	Energy from oven = Energy to raise metal temperature + Energy to melt metal 4.4 kW x 4(60x60) = 0.15 x 0.13k x (85 – 25) + (0.15 x l_f) l_f = 422 000 kJ kg^{-1}	1 1 1
12c		

	Correct shape Axes labelled and values of temperature correct	1 1
12d	The energy absorbed during the melting process is used to overcome the forces of attraction between the molecules /increase the potential energy and no energy goes to increase the kinetic energy of the particles.	1 1
12e	Melt the metal by placing it in a beaker of hot water. Hold stick down and let the metal solidify.	1
13a	P = 0.40 kW P = Fv $0.4 \times 10^3 = F \times 2$ F = 200 N	1 1 1
13bi	Energy = PT $= (1.9 \times 10^3) \times (30 \times 60)$ = 3.42 MJ	 1 1
13bii	Efficiency = output / input x 100 $40/100 = 3.42 \times 10^6$ / input energy Input energy = 8.55 MJ Total amount of fuel = 8.55 / 45 = 0.190 kg	 1 1
13ci	Since distance travelled by boat A and B are equal, area under both graphs are equal. $900 \times 1.5 = ½ \times 900 \times v$ v = 3 m/s	1
13cii	Boat A, the energy output from the engine is used to overcome friction as well as increase the kinetic energy of the boat.	1 1
E14 ai	Same Number of collisions that molecules make on the wall per unit time / frequency of collisions with wall are same on face A and B	1 1
E14 aii	Assumption is that temperature is constant. At constant mass, when volume of the gas decreases, rate of collision increases and pressure increases.	1 1
E14 aiii	Pg = hpg + Patm = 20 cm water + 10 m water = 10.2 m water F = PA = (10.2 x 1000 x 10) x (0.001) = 102 N	 1 1 1
E14 bi	As the temperature increases, the kinetic energy of the molecules increase and the collisions per unit volume increases. Hence, water level increases.	1
E14 bii	The difference in water level is not linearly related to the temperature rise Water has a high heat capacity meaning that large amounts of thermal energy is needed for a rise in temperature Or Water has a low boiling point which makes the thermometer unsuitable for the measurement of high temperatures.	1 1

O14 a	 Reaction forces Weight of plank Weight of Bryant	 1 1 1
O14 b	Taking moments about the brick, 150 x 0.78 + 620 x d = 300 x 1.56 d = 0.57 m cg is 0.99 m from toes	 1 1 1
O14c	As he gets up, his centre of gravity is shifted to the right closer to the scale, so the reading increases.	1 1
O14 d	Total up forces = total down forces R + 300 = 620 + 150 R = 470 N Reading on the scale = 47 kg	 1 1