| Class | Register Number | Name |
|---|---|---|
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# 南洋女子中学校
# NANYANG GIRLS' HIGH SCHOOL
## End-of-Year Examination 2016
## Secondary Three

**PHYSICS** **1 hour 45 minutes**

**Paper 2** Theory Paper **10:00 – 11:45**

**Monday** **10 October 2016**

No additional materials are required.

**READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**
Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Write in dark blue or black ink. You may use a pencil for any diagrams or graphs.
Do not use correction fluid or tape.

**Section A (40 marks)**
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

**Section B (30 marks)**
Answer **all** questions.
Question **10** has a choice of parts to answer: **10** ***Either*** or **10** ***Or*****.**
Write your answers in the spaces provided on the question paper.

At the end of the examination, **circle 10 Either** or **10 Or** in the grid on the right to indicate which question you have answered.

**INFORMATION FOR CANDIDATES**

The intended number of marks is given in the brackets [ ] at the end of each question or part question. You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

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.
The use of an approved scientific calculator is expected, where appropriate.

The acceleration due to gravity (or gravitational field strength) $g$ is taken to be 10 m $s^{-2}$ (or 10 N $kg^{-1}$) near the Earth's surface.

| Examiner's Use | |
|---|---|
| **Section A (40 marks)** | |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| **Section B (30 marks)** | |
| 8 | |
| 9 | |
| 10 Either | |
| 10 Or | |
| Paper 2 (70 marks) | |

| Paper 1 (30 marks) | |
|---|---|

| Overall |
|---|
| % |

## Section A (40 marks)

Answer **all** questions.

Write your answers in the spaces provided.

**1** A student checks the purity of a small uniform aluminium block by measuring its density.

He first recorded the dimensions of the block as follows:

| | Height/ cm | Breadth / cm | Length/ cm |
|---|---|---|---|
| 1st reading | 2.25 | 1.92 | 2.05 |
| 2nd reading | 2.23 | 1.90 | 2.04 |
| Average | 2.24 | 1.91 | 2.045 |

**(a)** Name the instrument that the student used.

..... [1]

**(b)** State one error that the student made in the tabulation of his results.

.....

..... [1]

**(c)** He then went on to measure the mass of the block as 23.9 g and the weight of the block as 0.236 N.

**(i)** Determine the gravitational field strength where the measurements were made.

gravitational field strength = ..... [1]

**(ii)** Calculate the density of the block.

density of block = ..... [3]

**2** A boy threw a ball upwards vertically at a velocity of 16.0 m $s^{-1}$. The ball reaches its maximum height and then falls freely under gravity, hitting the ground 4.0 s after it left the boy's hand.

**(a)** Calculate the time it takes for the ball to reach its maximum height.

time taken = ..... [2]

**(b)** Determine the velocity of the ball when it hits the ground.

velocity = ..... [2]

**(c)** Assume upwards as the positive direction. Sketch
**(i)** the velocity-time graph, and
**(ii)** the corresponding displacement-time graph over the 4.0 s interval.
Label the key values on each graph. [4]


**3** Fig. 3.1 shows a ball that starts from rest at R, rolls down a smooth ramp to S and then rolls over a furry carpet.

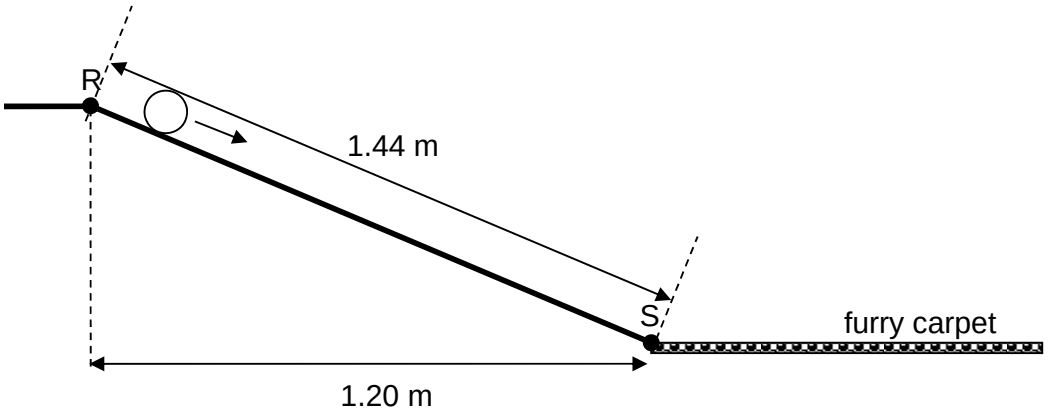



**Fig. 3.1**

**(a)** State the principle of conservation of energy.

.....

.....

..... [2]

**(b)** The mass of the ball is 450 g. Calculate the loss in gravitational potential energy between R and S.

loss in gravitational potential energy = ..... [3]

**(c)** Determine the speed of the ball when it reaches point S.

speed of ball = ..... [2]

**(d)** The ball comes to rest after rolling for a short distance on the carpet. Explain if the law of conservation of energy still applies in this case.

.....

.....

..... [1]

**4** Fig. 4.1 below shows a balancing toy made from a flat piece of cardboard paper cut-out with two small lumps of plasticine of equal mass affixed at X and Z.

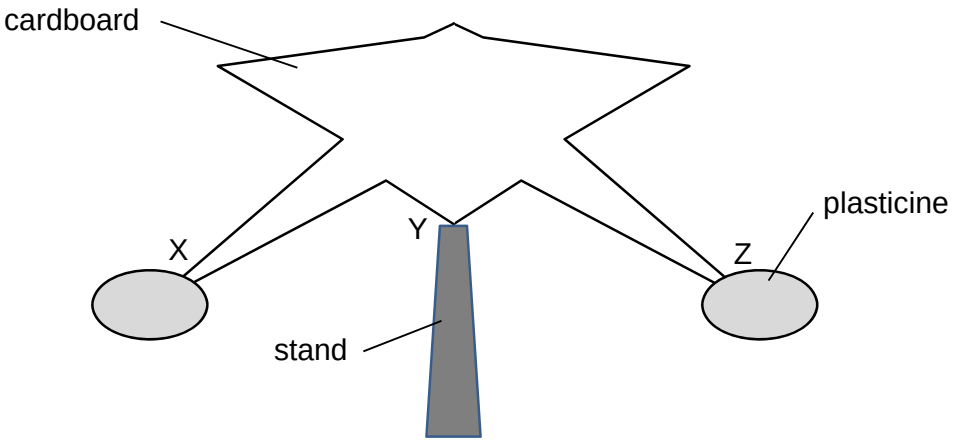



**Fig. 4.1**

It is balanced on a stand at Y.

**(a)** Explain the effect of the two lumps of plasticine on the stability of the toy.

.....

.....

..... [2]

A force acting at Z causes the cardboard to be tilted as shown in Fig. 4.2.

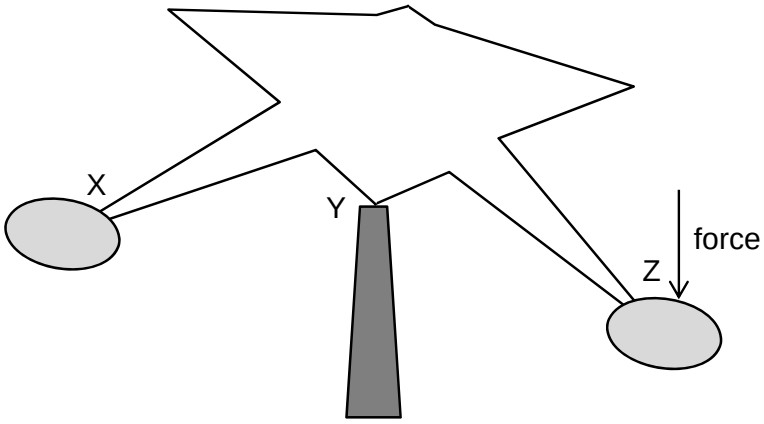



**Fig. 4.2**

**(b)** Describe and explain what happens to the toy when the force acting on Z is removed.

.....

.....

..... [2]

**5** **(a)** State the two laws of reflection.

.....

.....

..... [2]

**(b)** In Fig. 5.1 below, the vertical arrow represents a 1.60 m tall girl standing 2.00 m in front of a mirror. Her eyes are at a height of 1.50 m from the ground.

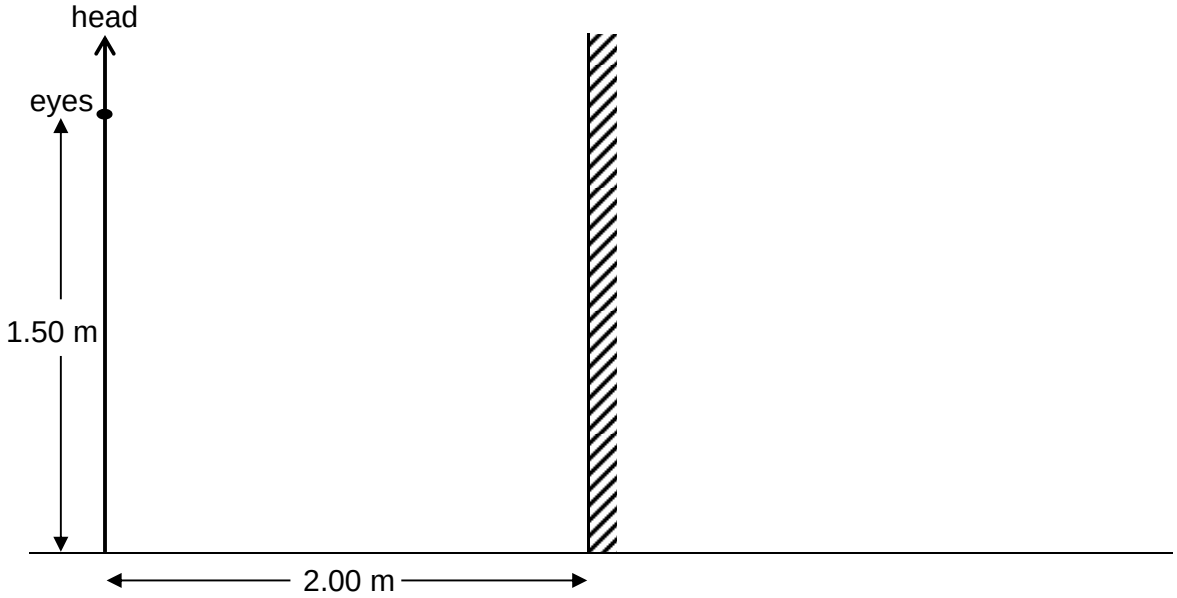



**Fig. 5.1**

**(i)** Draw rays on Fig. 5.1 to show how the girl can see her full image in the mirror. [2]

**(ii)** Determine the minimum length of the mirror that will allow the girl to see her full image. Show your working clearly.

minimum length of mirror = ..... [2]

**(iii)** Determine the height above the ground that the minimum length mirror must be positioned in order for the girl to see her whole image.

height of mirror above the ground = ..... [1]

**6** A kite of mass 0.25 kg is flying at constant velocity of 0.12 m $s^{-1}$ in the sky. The force of the wind can be seen as a single force of 7.4 N acting at an angle of 30° to the horizontal as shown in Fig. 6.1.

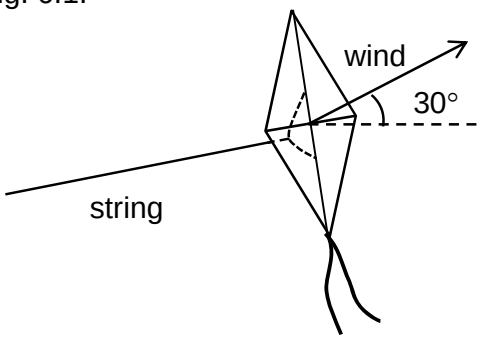



**Fig. 6.1**

By means of a scale diagram, determine the magnitude of the tension in the string that is pulling the kite.

magnitude of tension = ..... [3]

**7** Fig 7.1 below shows a rubber party balloon that has been filled with helium gas.

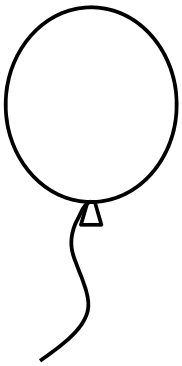


**Fig. 7.1**

When the balloon is released from the ground, it rises up in the air**.**

**(a)** State and explain how the volume of the balloon will change as it rises up in the atmosphere.

.....

.....

..... [2]

**(b)** A balloon has a volume of $4.2 \times 10^{-6}$ $m^3$ at sea level. Calculate the volume of the balloon at an altitude where the pressure inside it is 0.30 times the atmospheric pressure.

volume = ..... [2]

## Section B (30 marks)

Answer questions **8, 9** and **only** one **of the alternative questions in** Question **10**.

Write your answers in the spaces provided.

**8** Fig. 8.1 is drawn to scale and shows a ray of light travelling from air into material M. The incident ray makes an angle of 35° with the boundary. Some of the light is reflected at the surface but most passes into the material and is refracted. The refracted ray makes an angle of 63° with the boundary.

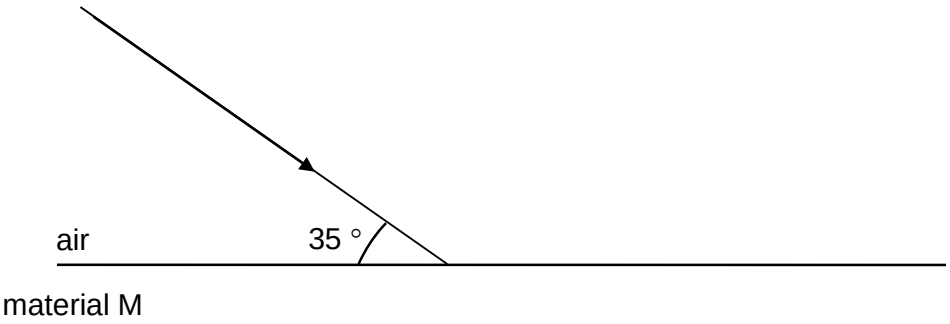



**Fig. 8.1**

**(a)** Complete Fig 8.1 to show the reflected and the refracted rays accurately. [2]

**(b)** Determine the angle of deviation for the reflected ray.

angle of deviation = ……. [1]

**(c)** Calculate the refractive index of material M. Show your working clearly.

refractive index of M = ..... [2]

**(d)** Explain why it is not possible for total internal reflection to occur for the incident ray shown in Fig 8.1.

.....

.....

..... [1]

**(e)** Fig. 8.2 (not drawn to scale) shows rays of light travelling in material G from a light source, L.

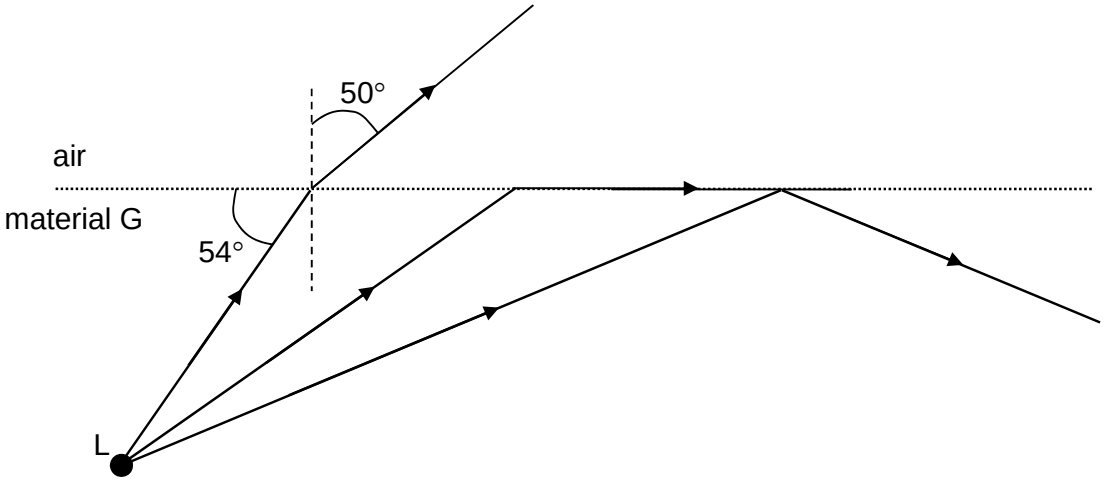


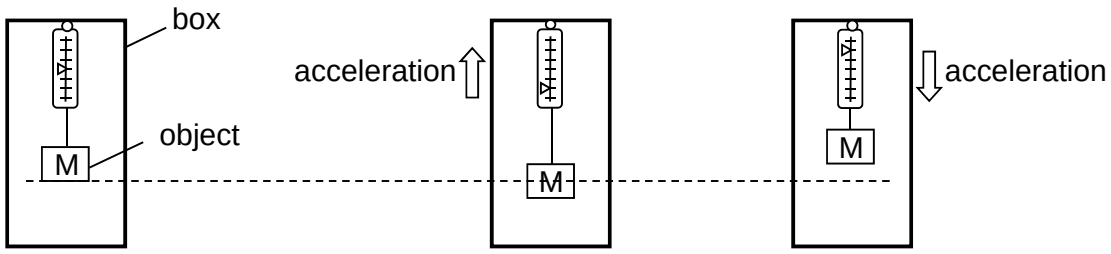

**Fig. 8.2**

**(i)** Mark the critical angle in Fig. 8.2 and label it C. [1]

**(ii)** Using information from Fig. 8.2, calculate the critical angle of light in material G. Show your working clearly.

critical angle = ..... [3]

**9** An accelerometer is a device for measuring acceleration. The principle of a simple accelerometer can be illustrated by suspending an object by a spring balance inside a box.



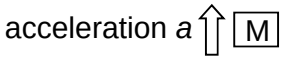

at rest — **Fig. 9.1**

accelerating upward — **Fig. 9.2**

accelerating downward — **Fig. 9.3**

Fig. 9.1 shows the position of the object of mass M when the box is at rest.
Fig. 9.2 and Fig. 9.3 show the position of the object when the box accelerates upward and accelerates downward respectively.

**(a) (i)** Draw a labelled free-body diagram in the space provided below showing the forces acting on the object when the box accelerates upward with acceleration *a*. [2]




**(ii)** Explain why the position of the object changes from Fig. 9.1 to Fig. 9.2 as the box accelerates upward.

.....

.....

.....

..... [2]

**(iii)** The weight of the object is 5.0 N. Determine the corresponding acceleration of the box when the reading on the spring balance is 6.2 N.

acceleration = ..... [2]

**(b)** If the object has a weight of 5.0 N, describe two possible motions of the box when the reading on the spring balance is 5.0 N.

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..... [2]

**(c)** Describe how the simple accelerometer in Fig. 9.4 can be modified to measure both vertical and horizontal acceleration.

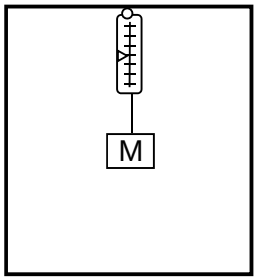


**Fig. 9.4**

.....

.....

.....

..... [2]

**10 EITHER**

A ladder with a weight of 100 N leans against a smooth vertical wall as shown in Fig. 10.1.

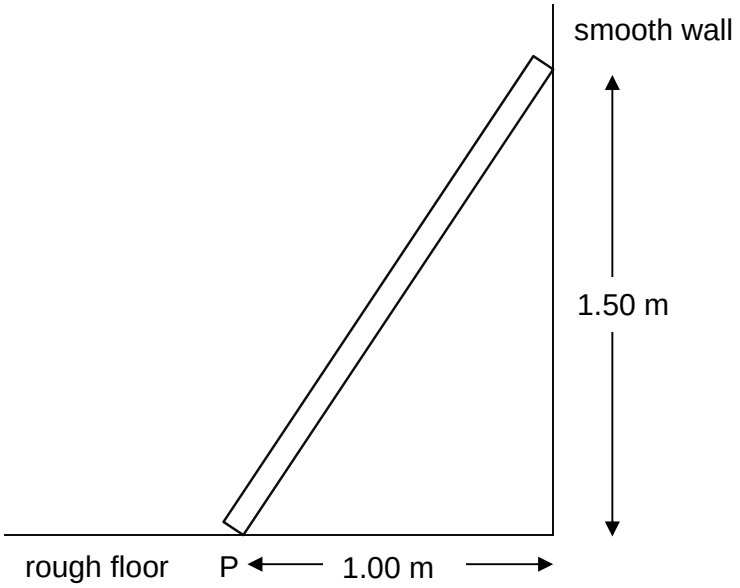


**Fig. 10.1**

The floor is rough. Assume that the centre of gravity of the ladder is in its middle.

**(a)** Explain what is meant by *centre of gravity*.

.....

.....

..... [1]

**(b)** Draw and label all the forces acting on the ladder. [3]

**(c)** State the magnitude of the normal contact force by the floor on the ladder.

normal contact force = ..... [1]

**(d)** Calculate

**(i)** the normal contact force by the wall on the ladder, and

**(ii)** the frictional force $f$, acting on the ladder.

normal contact force = ..... [2]

frictional force, $f$ = ..... [1]

**(e)** Explain why the ladder shown in Fig. 10.1 is more likely to slip when a man is high up on it than when he just begins to climb.

.....

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.....

.....

..... [2]

**10 OR**

Fig. 10.2 shows a simple U-tube that contains two liquids, oil and water.

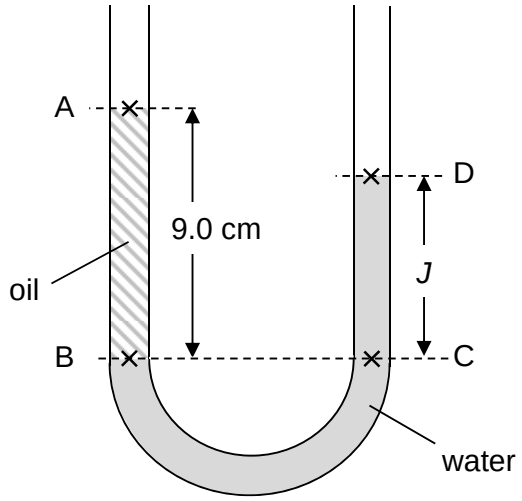


**Fig. 10.2**

Both ends of the U-tube are open to atmospheric pressure at A and D. The density of oil is $8.20 \times 10^2$ kg $m^{-3}$ while that of water is $1.00 \times 10^3$ kg $m^{-3}$.

**(a)** Explain *atmospheric pressure* and state its SI unit.

.....

.....

.....

..... [2]

**(b) (i)** State the pair(s) of points that experience(s) the same pressure.

.....

..... [2]

**(ii)** Calculate the height *J*.

*J* = ..... [2]

**(c)** Water is poured into the right arm of the U-tube until the oil in the left arm of the U-tube reaches the top of the tube, and a coin of weight 0.017 N is placed on the left arm of the U-tube as shown in Fig. 10.3.

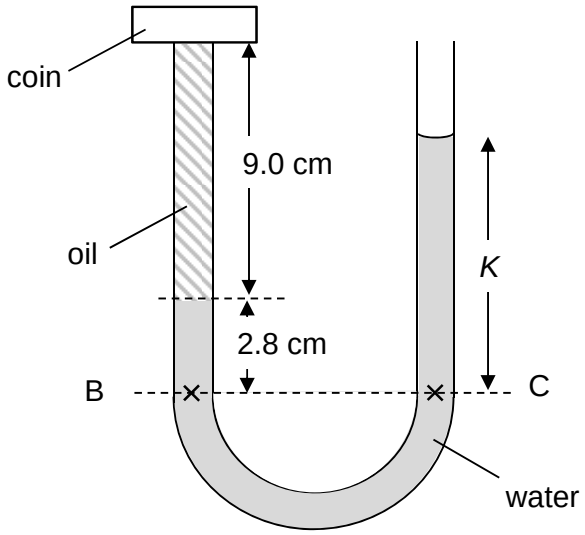


**Fig. 10.3**

The diameter of the U-tube is 12 mm.

When the coin is about to be pushed out by the oil, calculate

**(i)** the pressure exerted by the coin on the oil,

pressure = ..... [2]

**(ii)** the height *K* of the water in the right arm.

height *K* = ..... [2]

**End of Paper**

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