YUYING SECONDARY SCHOOL
MID-YEAR EXAMINATION
Secondary 3 Express

NAME _____

CLASS _____ **REG. NO** _____

SCIENCE

5076, 5077

Physics

12 May 2017

1 hour and 15 minutes

Candidates answer on the Question Paper.
Additional material: Multiple Choice Answer Sheet

Setter: Mr Goh Ser Meng

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet and the separate Answer Sheet.

Section A
There are **twenty** questions on 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 Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Read the instructions on the Answer Sheet very carefully.

Write in dark blue or black pen on both sides of the paper (for Sections B and C.)
You may use a pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section B
Answer **all** the questions in the spaces provided.

Section C
Answer **any two** of the questions in the spaces provided.

The number of marks is given in brackets [ ] at the end of each question or part question.
The use of an approved calculator is expected, where appropriate.

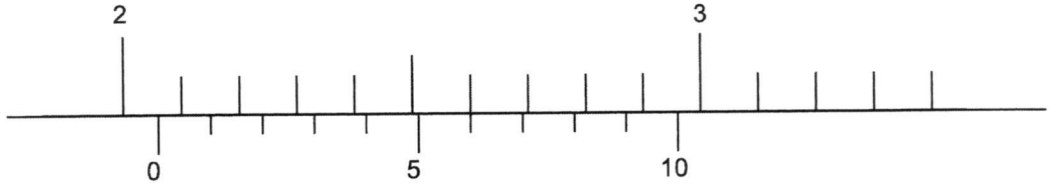
For Examiner's Use	
Total	/65

This document consists of **22** printed pages.

Section A

Answer **all** the questions in this section.
The total mark for this section is 20.

1. The diagram below shows the reading on the scale of a pair of vernier calipers.



What is the reading of the vernier calipers?

A. 2.06 mm B. 2.06 cm C. 2.56 mm D. 2.56 cm

2. Which of the following lists contains **one** vector quantity and **two** scalar quantities?

A. acceleration, displacement, velocity
B. distance, force, velocity
C. force, length, time
D. length, mass, speed

3. The data of three pendulums **X**, **Y** and **Z** are recorded in the table below.

	Mass of pendulum bob/g	Length of pendulum/cm
X	150	100.0
Y	100	30.0
Z	50	50.0

Which of the following statements is true about their periods?

A. All three pendulums have the same period.
B. Period of **X** is longer than period of **Y** because its pendulum bob has a greater mass.
C. Period of **Y** is longer than period of **Z** because **Y** has a shorter length.
D. Period of **Z** is shorter than period of **X** because **Z** has a shorter pendulum length.

4. An astronaut brings a weighing scale and mass balance to the Moon and measures some properties of a rock there. He brings the rock back to Earth and does the same measurements.

Which instrument will show a different reading and why?

	Instrument	Reason
A.	Weighing scale	The gravitational field strength on Earth is higher.
B.	Weighing scale	The spring in the weighing scale is stronger on Earth.
C.	Mass balance	The rock is heavier on Earth compared to when on the Moon.
D.	Mass balance	The rock became more compact on Earth due to higher atmospheric pressure.

5. The densities of four liquids are given in the table below. An object is placed into the liquids and the observations recorded.

Liquid	Density/ gcm^{-3}	Observation
Alcohol	0.82	sinks
Oil	0.91	sinks
Water	1.00	sinks
Glycerin	1.26	floats

Which statement is true about the density of the object?

A. It is lower than 0.82 g/cm^3.
B. It is between 0.82 g/cm^3 and 0.91 g/cm^3.
C. It is between 0.91 g/cm^3 and 1.00 g/cm^3.
D. It is between 1.00 g/cm^3 and 1.26 g/cm^3.

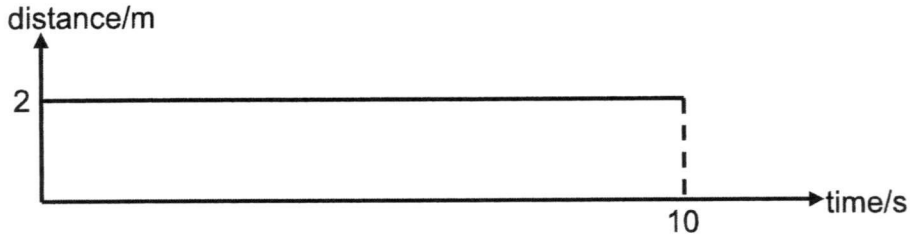
6. Four objects are made from different materials. The masses and volumes of the objects are shown below.
Which object has the greatest density?

	Mass / kg	Volume / m^3
A.	40	8
B.	32	4
C.	20	5
D.	18	6

7. Two boxes of different masses are lined up against a wall. An old lady tried to shift the boxes aside. She found one box easier to move and easier to stop.
Which is the box that is easier to move and which is the one easier to stop?

	easier to move	easier to stop
A.	box with greater mass	box with greater mass
B.	box with greater mass	box with less mass
C.	box with less mass	box with greater mass
D.	box with less mass	box with less mass

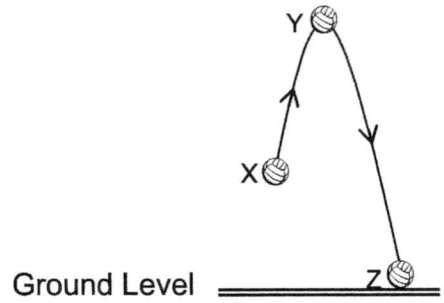
8. Which of the following best describes the distance-time graph shown below?



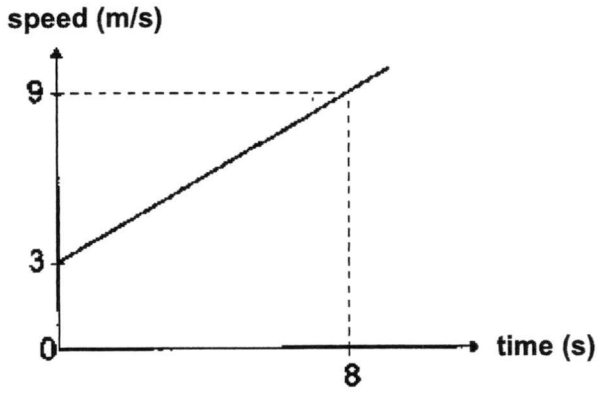
A. An object travels at constant speed of 2 m/s.
B. An object travels at constant velocity of 2 m/s.
C. An object travels at constant acceleration of 2 m/s^2.
D. An object is not moving.

9. A ball is thrown vertically upwards with an initial velocity of 5 m/s. After 3 s it falls to ground level. Assuming air resistance is negligible, which statement about the acceleration of the ball is correct?

A. It is least at **X**.
B. It is same at **X**, **Y** and **Z**.
C. It is zero at **Y**.
D. It is greatest at **Z**.

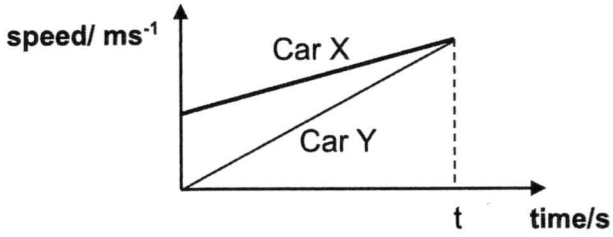


10. The graph below shows how the speed of a bus varies with time.
What is the distance travelled by the bus in the first 8 seconds?



A. 9 m
B. 24 m
C. 48 m
D. 72 m

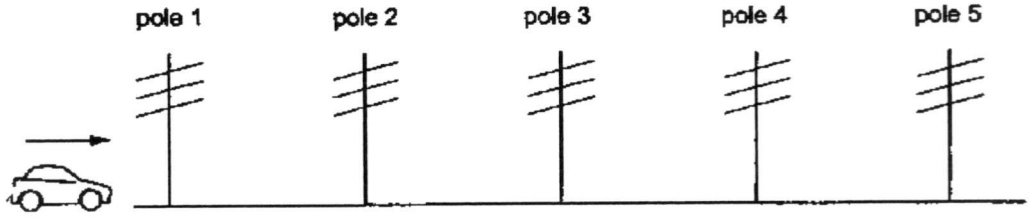
11. The graph below shows how the speed varies with time for two cars, X and Y.



Which of the following statements is correct?

A. Both cars travel the same distance after time t.
B. Car X moves at a lower speed than Car Y.
C. Both cars come to a stop at time t.
D. The acceleration of car Y is greater than the acceleration of car X.

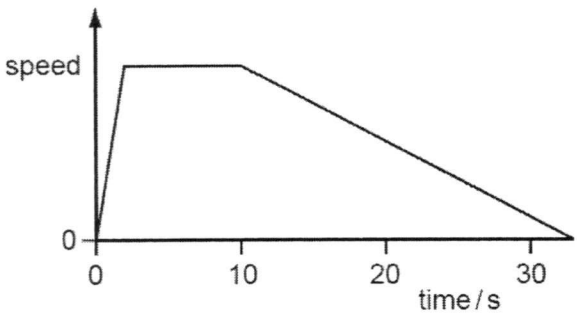
12. Telegraph poles are positioned at equal distances along the side of the road. A car accelerates uniformly until it is level with pole 4. The car then continues along the road at the new steady speed. The times to travel between the poles are measured.
Which time is the shortest?



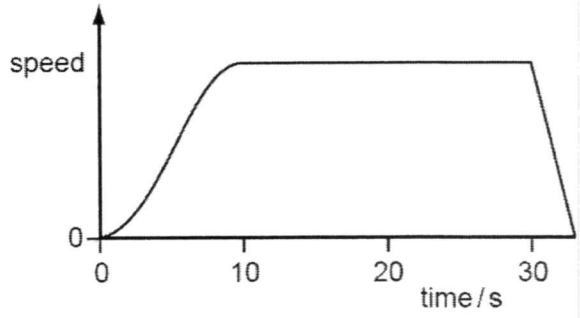
A. pole 1 to pole 2
B. pole 2 to pole 3
C. pole 3 to pole 4
D. pole 4 to pole 5

13. A car accelerates for 10 s. It stays at a steady speed for 20 s and then brakes to a stop in 3 s.
Which of the following graphs represents the journey travelled by the car?

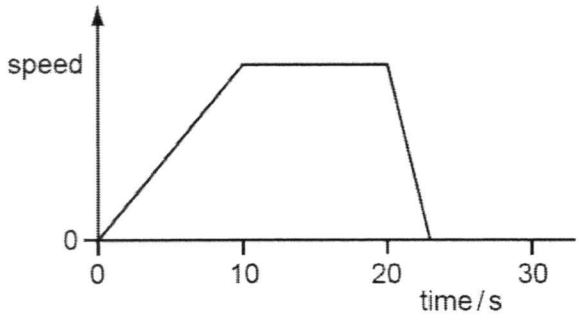
A.



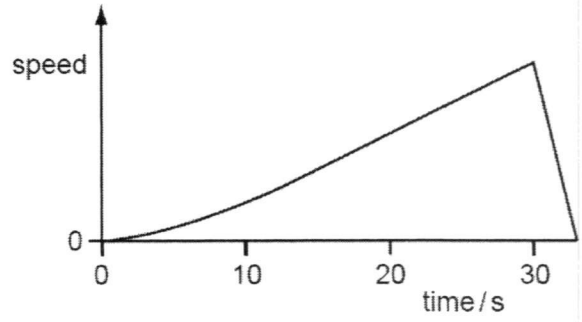
B.



C.

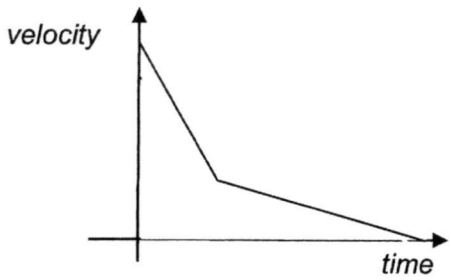


D.

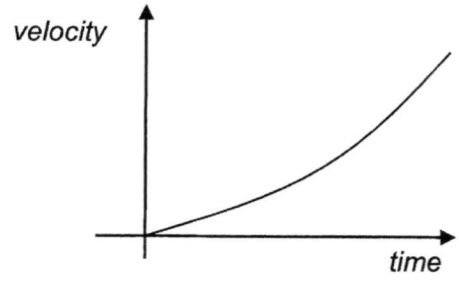


14. Which graph below shows an object moving with **constant** acceleration?

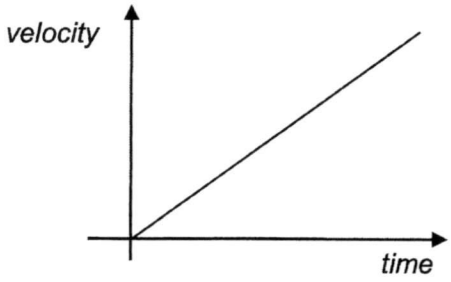
A.



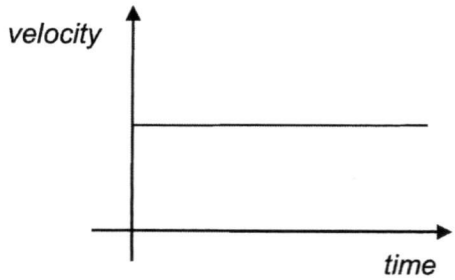
B.



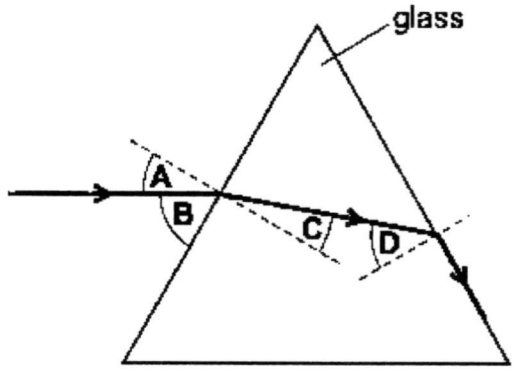
C.



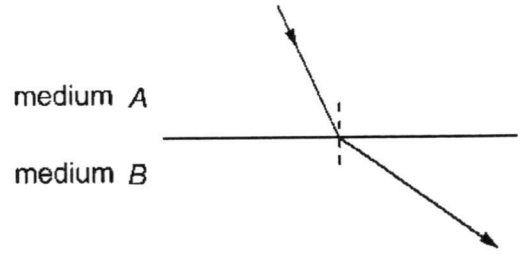
D.



15. The diagram shows the passage of a ray of light through a triangular glass block. Which of the following represents the critical angle?



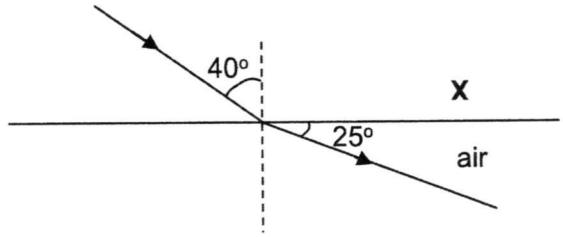
16. In the figure shown below, a light ray is passing from medium ***A*** to medium ***B***.



Which of the following are possible materials for media ***A*** and ***B***?
(The refractive index of glass, alcohol, diamond and water are 1.54, 1.36, 2.42 and 1.33 respectively.)

	Medium ***A***	Medium ***B***
A.	Glass	Alcohol
B.	Glass	Diamond
C.	Alcohol	Diamond
D.	Water	Glass

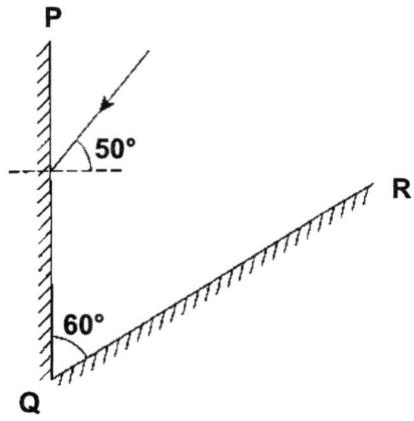
17. A ray of light is travelling from material X to air as shown in the diagram.



What is the refractive index of this material?

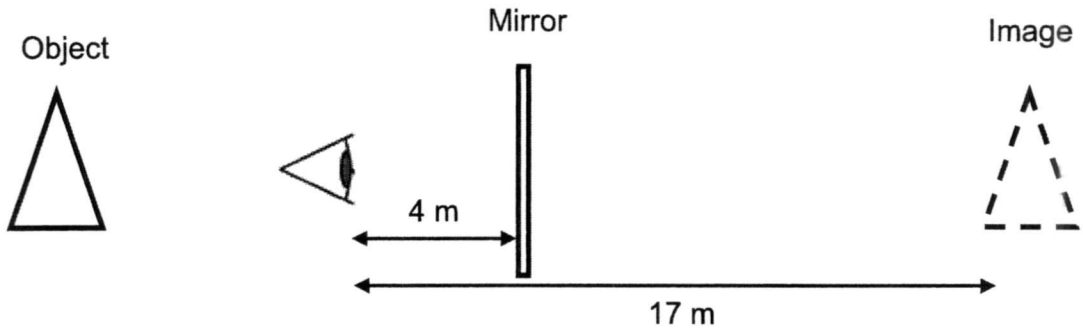
A. $\sin 65^0 / \sin 40^0$
B. $\sin 25^0 / \sin 40^0$
C. $\sin 40^0 / \sin 65^0$
D. $\sin 40^0 / \sin 25^0$

18. A ray of light is incident at an angle of 50° to a mirror PQ. Another mirror QR is arranged at an angle of 60° to PQ. After reflection from PQ, the ray is incident on QR. What is the angle of incidence of the ray at the **mirror QR**?



A. 10°
B. 30°
C. 50°
D. 60°

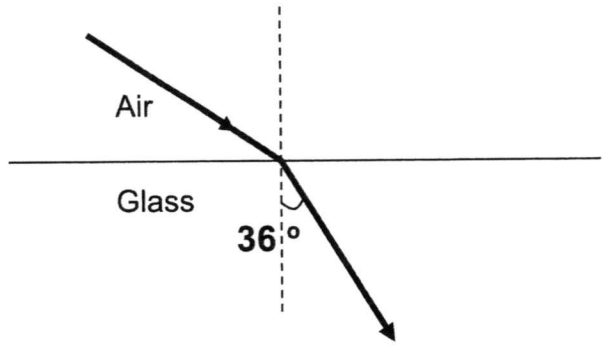
19. The diagram (not drawn to scale) shows a person looking at an image of an object in a plane mirror. The image is 17 m from the person and the person is 4 m from the mirror.



What is the distance from the object to the person?

A. 4 m
B. 9 m
C. 13 m
D. 21 m

20. A ray of light incident on a glass block is refracted at an angle of 36°. If the refractive index of glass is 1.50, what is the angle of incidence?



A. 28°
B. 36°
C. 54°
D. 62°

Section B

Answer **all** the questions in this section in the spaces provided.
The total mark for this section is **25**.

1. Fig. 1.1 shows an astronaut. Four astronauts are standing on four different planets. One of these planets is Earth, which has a gravitational field strength of 10 N/kg.
Fig. 1.2 shows the mass and weight of each astronaut as they stand on the four planets.

Astronaut	Mass / kg	Weight / N
A	70	140
B	60	600
C	50	1000
D	80	160

Fig. 1.2

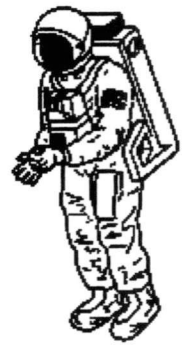


Fig. 1.1
Fig. 3.1

(a) Explain what is meant by gravitational field strength. [1]

_____

_____

(b) Which astronaut is on Earth? Explain your answer with relevant working.

Astronaut _____ [2]

(c) Which astronaut would weigh the least on Earth? Explain your answer. [2]

_____

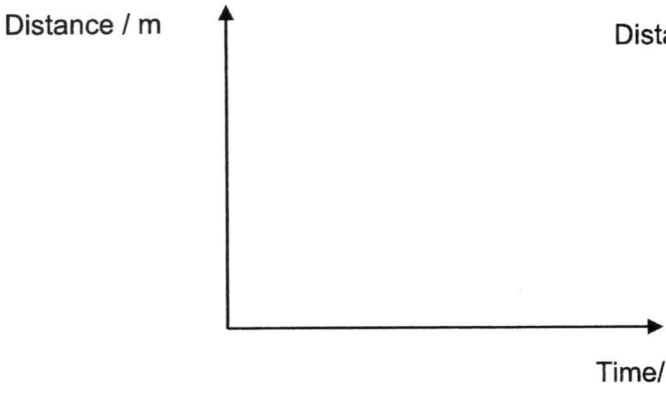
_____

2. (a) State the quantity represented by the gradient of the distance-time graph? [1]

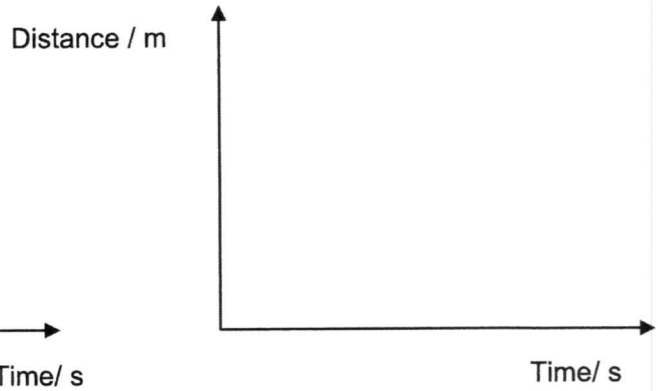
_____

(b) Sketch, in the following diagrams, the **distance-time** graph of an object travelling with [2]

(i) **constant speed**



(ii) **increasing speed**



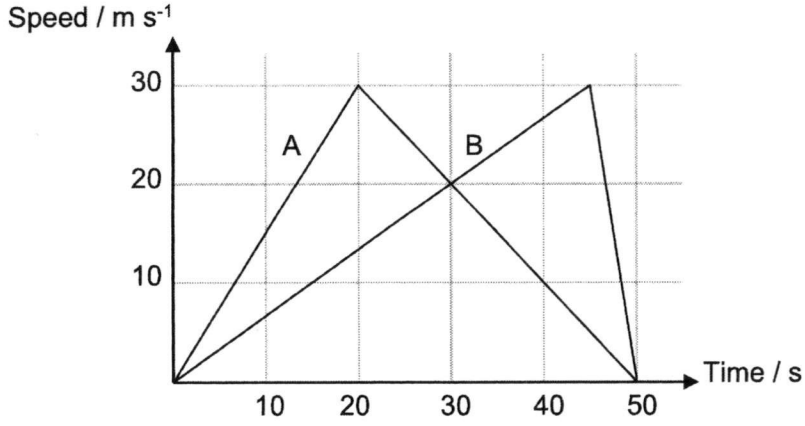
3. (a) Define **acceleration**. [1]

_____

_____

(b) A marathon runner accelerates uniformly from 10 m/s to 16 m/s in 5 seconds. Calculate his acceleration. [2]

4. The speed-time graph for two cars A and B in a race are shown in the diagram below.



(a) Find the acceleration of Car A from t = 0 s to t = 20 s.

Acceleration: _____ [1]

(b) Describe the motion of Car A after t = 20 s. [1]

_____

_____

(c) Determine the difference in the distance travelled by Car A and B at the time when they are having the same speed.

Difference in distance travelled: _____ [3]

5. John wants to determine the purity of a small, uniform rectangular bar of iron by determining its density. He measures the dimensions of the bar and wrote down these values:

length = 8.0 cm, width = 6.5 cm, and thickness = 5.2 cm.

(a) John has recorded every digit of the readings from the measuring instrument that he used.
Suggest the name of the instrument used. [1]

_____

(b) John measures the mass of the bar as 239.4 g. [2]
Calculate the density of the bar in g/cm^3.

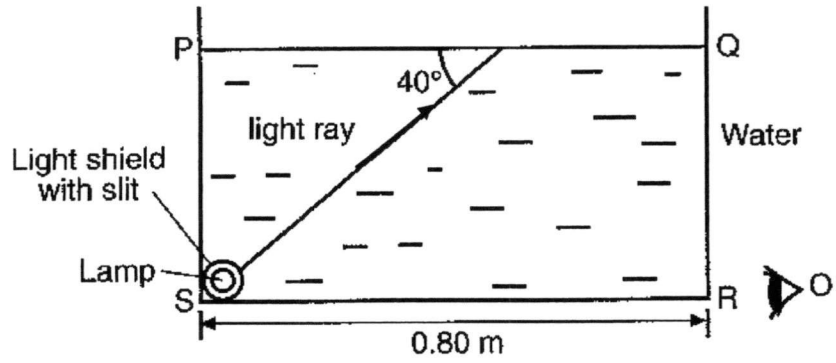
density = _____ g/cm^3

(c) The density of pure iron is 7.87 g/cm^3. State and explain whether the bar is made of pure iron. [2]

_____

_____

6. The figure below shows a side view of a water-filled aquarium PQRS. An electric lamp, surrounded by a shield with a narrow transparent slit, is immersed in one corner of the aquarium at S. The light ray from the slit shines on the water surface PQ at an angle of 40° as shown.



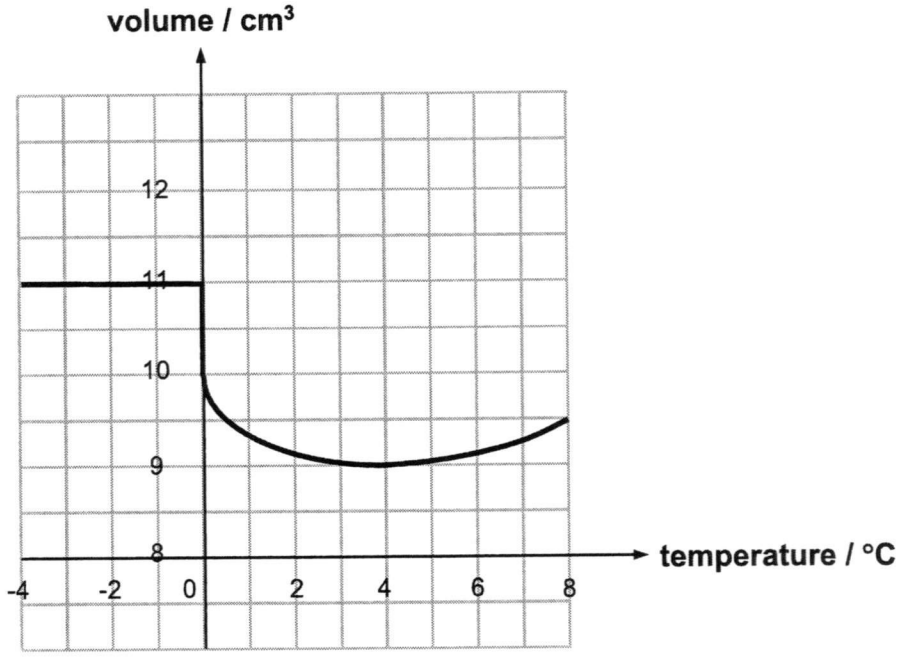
(a) If the refractive index of water is 1.33, calculate the critical angle for a ray travelling from water to air. [2]

(b) On the same diagram above, complete the path of the light ray after meeting the water surface **PQ** until it leaves the aquarium. [2]

Section C

Answer **any two** questions in this section in the spaces provided.
The total mark for this section is **20**.

1 (a) The graph below shows how the volume of 10 g of ice changes as the temperature rises from -4 °C to 8 °C. The melting point of ice is 0 °C.



(i) Calculate the density of ice at - 2°C. [2]

density = ... g cm^{-3}

(ii) Describe how the density of the water changes as the temperature increases from 0 °C to 8 °C. No further calculation is necessary. [2]

_____

_____

_____

_____

1 (b) (i) State one law of reflection. [1]

_____

(ii) A light ray travelling from an object **X** is shown in Fig. 1.1.

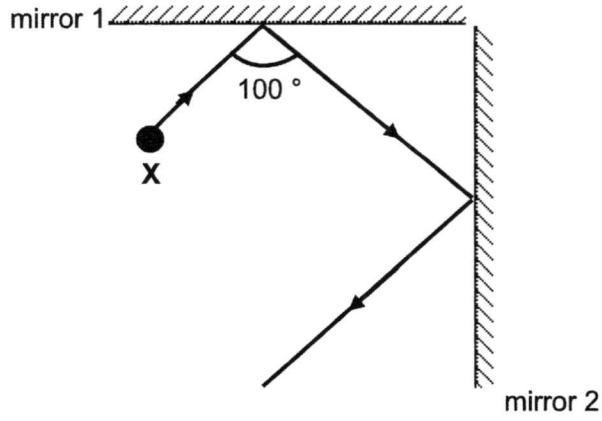


Fig. 1.1

(1) State the angle of reflection at mirror 1. [1]

_____

(2) Calculate the angle of reflection at mirror 2.

angle of reflection = _____ [1]

(3) State two properties of the image formed in mirror 1. [2]

_____

_____

(iii) Mirror 1 is now tilted at an angle of 10° as shown in Fig. 1.2.

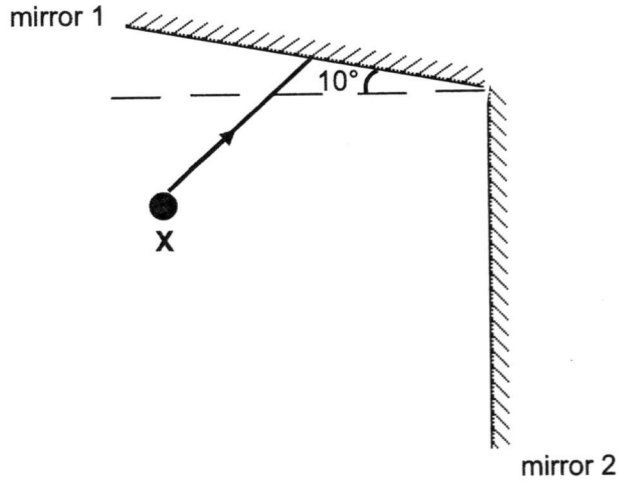


Fig. 1.2

Determine the angle of reflection at mirror 1.

angle of reflection = _____ [1]

2. In a car race called a "demolition derby", collisions between cars are common.
Fig. 2.1 is a graph showing the motion of a car during the first few seconds of a race.

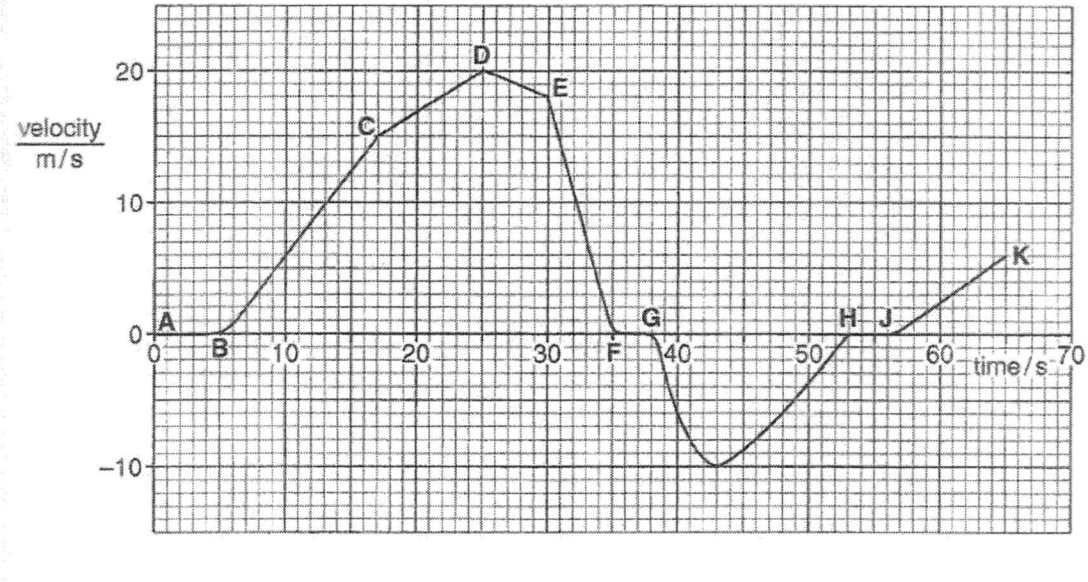


Fig. 2.1

(a) From **A** to **F**, Fig 2.1 shows the car

- braking
- colliding with another car and stopping
- increasing speed
- increasing speed at its greatest rate
- stationary

but not in this order.

Use each phrase once only to describe the motion of the car between point A and point F. [3]

A to **B** _____

B to **C** _____

C to **D** _____

D to **E** _____

E to **F** _____

(b) Describe the motion of the car between points **F** to **G**, **G** to **H**, **H** to **J** and **J** to **K**. [5]

_____

_____

_____

_____

(c) Calculate the average acceleration of the car between points C and D. [2]

3. A student conducts an experiment to study the bending of light in a glass block. Fig 3.1 shows the refraction of light when it travels from air to glass.

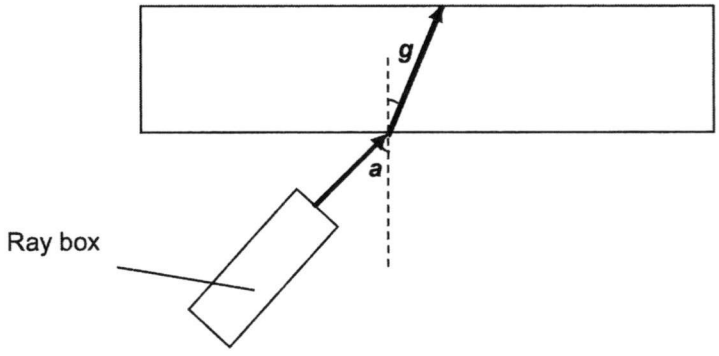


Fig. 3.1

Set of readings	Angle ***a*** in air	Angle ***g*** in glass
1st	40.0°	25.4°
2nd	?	15.0°

Table 3.1

(a) Explain why the direction of light changes as it passes from glass to air. [1]

_____

_____

(b) (i) Define refractive index of the glass. [1]

_____

_____

(ii) Calculate the refractive index of the glass. [2]

(iii) Calculate the missing value for the angle **a** in Table 3.1 above. [2]

(iv) Given that the speed of light in vacuum is 3×10^8 m/s, determine the value of the speed of light in the glass block. [2]

(c) If the glass block is replaced by a diamond block which has a higher refractive index, state the change (if any) in: [1]

(i) the speed of light and [1]

_____

(ii) the size of angle **g** in the diamond compared to that in glass block.

_____

END OF PAPER

Yuying Sec School Sec 3 Express Science Physics MYE 2017

Section A

1	B	11	D
2	C	12	D
3	D	13	B
4	A	14	C
5	D	15	D
6	B	16	A
7	D	17	A
8	D	18	A
9	B	19	B
10	C	20	D

Section B

1a It is gravitational force of attraction acting per unit mass [1]

b Astronaut B. [1]

Since W = mg, g = 600/60 = 10 N/kg which is the gravitational field strength on earth. [1]

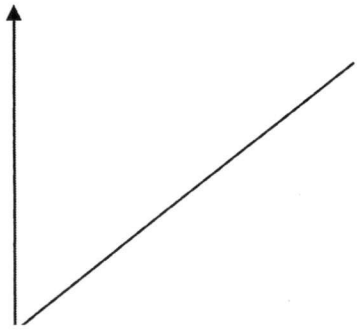
c Astronaut C [1]

because it has the lowest mass and gravitational field strength is a constant. [1]

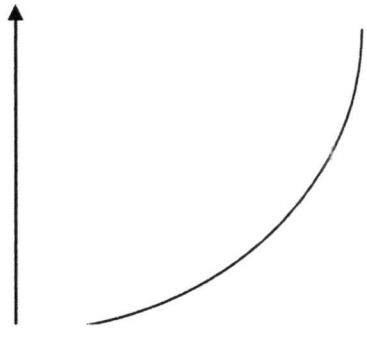
2. (a) speed [1]

(b) Sketch the distance-time graph of an object travelling with

(i) constant speed [1]



(ii) increasing speed [1]



3. (a) The rate of change of velocity per unit time [1]

(b) a = (16 – 10) / 5 [1]

= 1.2 m/s^2[1]

4. (a) a = (30-0)/20
= 1.5 m/s^2 [1]

(b) speed decreases uniformly / uniform deceleration [1]

(c) Distance travelled by Car A = ½(20x30) + ½(20+30)x10
= 300 + 250
= 550 m [1]

Distance travelled by Car B = ½(30x20)
=300m [1]

Difference = 550 -300 = 250m [1]

5

(a) metre rule

(b) Density = m / v

$$= \frac{239.4}{8.0 \times 6.5 \times 5.2}$$ [1]

= 0.885 g cm^{-3} [1]

(c) No, it is not made from iron [1]

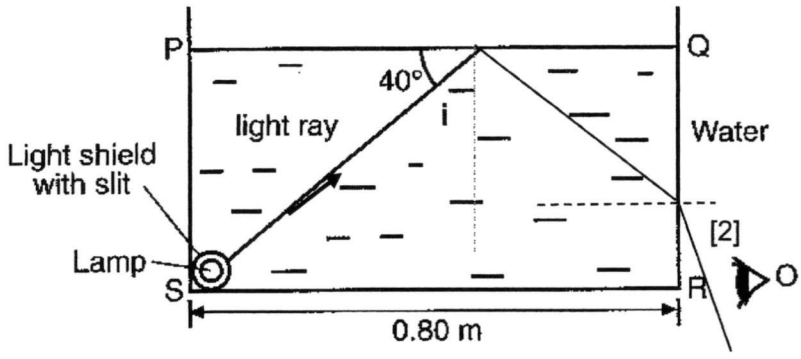
as the density is not the same as pure iron. [1]

6 a) $\sin c = 1/\eta$

$= 1/1.33$ [1]

$c = 48.8^0$ [1]

b) Path of reflected rays (with marks) as shown below.



Section C

1 (a)

$$\rho = \frac{m}{V}$$

$$= \frac{10}{11} \text{ [1]}$$

= 0.909 g cm^{-3} (3 s.f.) [1]

(b) The **density of the water increases when its temperature increases from 0 °C to 4 °C [1]**

and then **decreases when its temperature increases from 4 °C to 8 °C**. [1]

(deduct only one mark for lack of temperature ranges)

1 (b) (i) The law of reflection states that the incident ray, reflected ray and the normal all lie on the same plane. 1

The angle of incidence is equal to the angle of reflection.

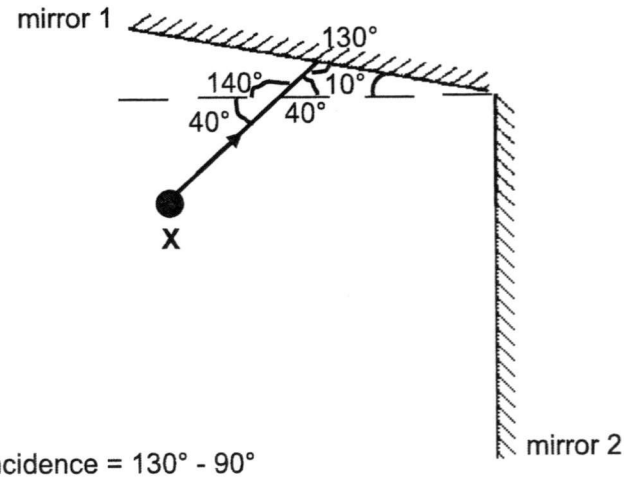
(ii)

(1) 50° 1

(2) 40° 1

(3) Virtual, upright, laterally inverted, same size of object. (any 2) 2

(iii)



Angle of incidence = 130° - 90°

= 40° [1]

Q2. (a) A to B : Stationary

B to C : Increasing speed at its greatest rate

C to D : Increasing speed

D to E : Braking

E to F : Colliding with another car and stopping

1/2 m for each wrong answer, no mark if all wrong)

(b) **From F to G**, the car is stationary [1] for a brief period of time before moving backwards from **G to H** [1]. The car reaches a maximum speed (of -10 m/s) in the backward direction [1], before its speed reduces to zero again (at 53s). From **H to J**, the remains stationary [1] again briefly before accelerating constantly (in the forward direction) [1] from **J to K.**

(c) $a = (v - u) / t$

$= (20 - 15) / (25 - 17)$ [1]

$= 5/8$

$= 0.625\ m/s^2$[1]

3(a) Refraction of light occurs. [1]

This is due to the different optical density between air and glass.

OR Glass is optically denser than air.

OR Light travels at different speeds in the 2 mediums.

(b) (i) As light enters from air into another medium, the ratio of the sine of angle of incidence to the ratio of the sine of angle of refraction is known as the refractive index of the medium. [1]

(ii) $n = \sin i / \sin r$ [1]

$= \sin 40 / \sin 25.4$

$= 1.50$ (2 or 3 s.f accepted) [1]

(iii) $1.50 = \sin a / \sin 15$ [1]

$\sin a = 1.50 \sin 15$

$a = 22.8°$ [1]

(iv) $n = c/v$ [1]

$V = c/n$

$= (3 \times 10^8)/1.5$

$= 2 \times 10^8$ m/s [1]

(c) (i) Speed of light in diamond is lower/lesser than speed of light is In the glass. [1]

Or Light travels slower in diamond than in glass.

(ii) Angle g in diamond is smaller that in glass. [1]