Subject : Physics Paper 2   Set by   : Pn Juzira Bt Bahiki
Form   : 5A – 5F   Checked by : En Tan Kok Tong
Date   : 22.5.2014 / Thursday   Approved by : En Pradeep Kumar C
Time   : 7.40 – 10.10 Pagi   (Head of Physic Panel)
No. of Candidates   : 278   Verified by : Pn Lew Poh Peng
No. of printed pages : 16   (Head of Science & Maths Department)
                                               Verified by : Pn Ean Yong Moon
                                                             (Senior Assistant for Administration)

Name :_____
Class : _____

SECTION A
[60 marks]
Answer **all** questions. Write your answer in the **space provided**.

1   Diagram 1.1 shows a vernier caliper is used to measure the thickness of 4 coins.
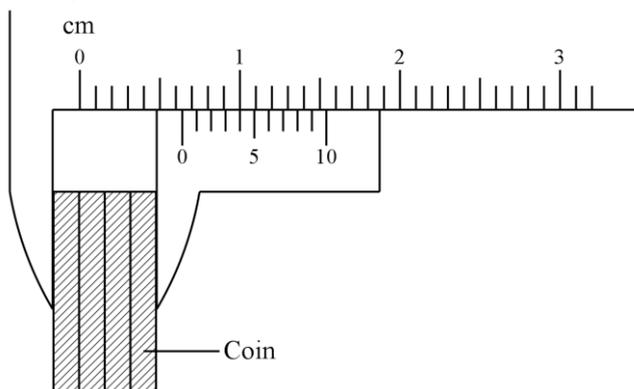

Diagram 1.1

(a) (i) What is the sensitivity of a vernier caliper?
         Tick (✔) the correct answer in the box provided.

         ☐ 0.01 cm   ☐ 0.01 mm

[1 mark]

(ii) What is the thickness of 2 coins?

_____

[1 mark]

(b) Diagram 1.2 shows the thickness of a piece of coin measured by two micrometer screw gauges, P (without zero error) and Q (with zero error).
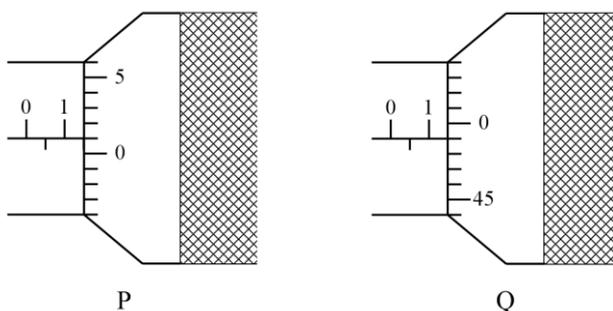

Diagram 1.2

(i) What is the zero error of Q?

_____

[1 mark]

(ii) The actual thickness of the coin is

_____

[1 mark]

1

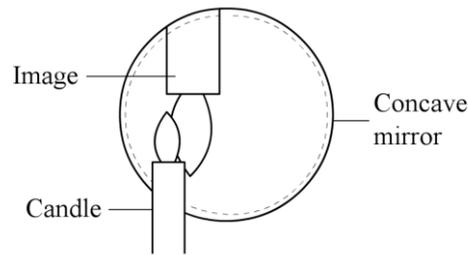**2**   Diagram 2.1 shows a candle is placed in front of a concave mirror. The image formed is observed.

Diagram 2.1

(a) Name the light phenomenon involved in the formation of the image.

_____

[1 mark]

(b) The image is inverted and magnified.
State **one** other characteristic of the image.

_____

[1 mark]

(c) Diagram 2.2 shows an incomplete ray diagram. *C* is the centre of curvature and *F* is the principal focus.
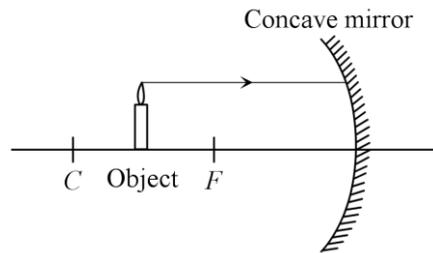
Diagram 2.2

Complete the ray diagram to show how the image is formed.

[3 marks]

3   Diagram 3 shows the positions where loud sounds can be heard when two loudspeakers are connected to an audio frequency generator.
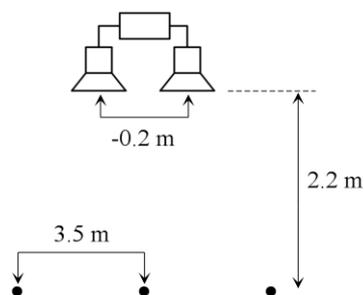
-0.2 m

2.2 m

3.5 m

Diagram 3

(a) Underline the correct answer in the bracket to complete the sentence below.
Sound wave is a (longitudinal, transverse) wave.

[1 mark]

(b) Why are loud sounds heard at that positions?

_____

[1 mark]

(c) Based on Diagram 3, calculate the wavelength of this sound wave.

[2 marks]

(d) The frequency of the sound wave is increased.
   (i) What will happen to the distance between consecutive loud sounds?

_____

[1 mark]

  (ii) Give **one** reason for your answer in (d)(i).

_____

[1 mark]

4   Diagram 4.1 shows the change of phase when 1 kg of steam is converted into ice.

<div align="center">

A   B

| 1 kg steam at 100°C | $\xrightarrow{P_1}$ | 1 kg water at 100°C |

$\downarrow P_2$

| 1 kg ice at 0°C | $\xleftarrow{P_3}$ | 1 kg water at 0°C |

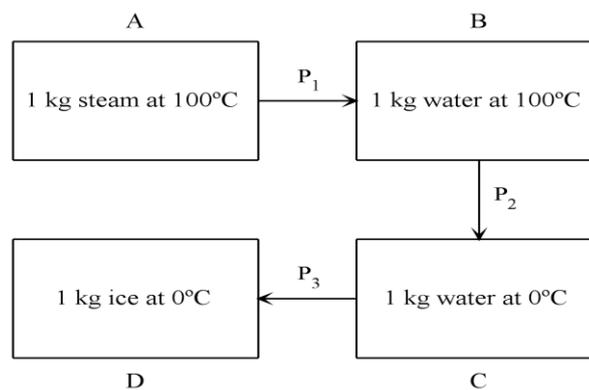D   C

Diagram 4.1
</div>

P_1, P_2 and P_3 are the heat energies released during the cooling process.
(a) Name the heat energy, P_3, which is released from C to D.

_____

[1 mark]
(b) State **one** reason why the temperature at C and D are the same even though heat is released.

_____

[1 mark]
(c) Calculate the heat energy, P_2, which is released from B to C.
   [The specific heat capacity of water, $c = 4\ 200\ \text{J kg}^{-1}\text{°C}^{-1}$]

[2 marks]

(d) Sketch the graph of temperature against time on Diagram 4.2 to show the change of phase from A to D.
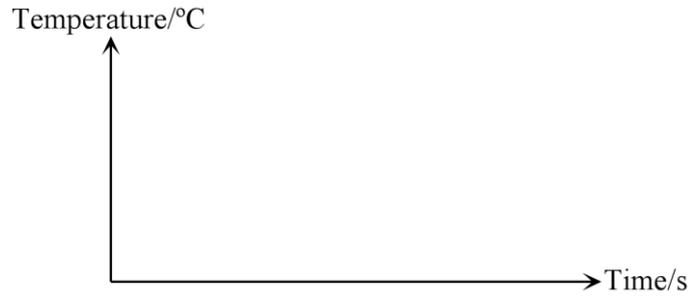
Temperature/°C

Time/s

Diagram 4.2

[2 marks]

5   Table 1 shows three types of pan and their characteristics.

Type of pan	Specific heat capacity	Mass
Copper pan	387 J kg^{-1}°C^{-1}	2.3 kg
Silver pan	235 J kg^{-1}°C^{-1}	2.8 kg
Aluminium pan	900 J kg^{-1}°C^{-1}	2.1 kg

Table 1

(a) What is the meaning of specific heat capacity?

[1 mark]

(b) Based on Table 1, state the suitable characteristics for the pan if it is to be used for cooking something rapidly. Give reason for the suitability of the material.
   (i) Material of the pan

   Reason

[2 marks]

   (ii) Mass of the pan

   Reason

[2 marks]

(c) The pans are heated by using an electric hot plate of power 500 W.
   Based on the information in Table 1, calculate the time taken to achieve a temperature rise of 56°C for:
   (i) Copper pan.

[2 marks]

   (ii) Silver pan.

[2 marks]

4

(iii) Aluminium pan.

_____

[2 marks]

(d) Which of the above pans is more suitable to be used in cooking?

_____

[1 mark]

6 Diagram 5.1 shows the original position of a paper.

Diagram 5.1

When air is blown on top of the paper, the paper changes its position as shown in Diagram 5.2.
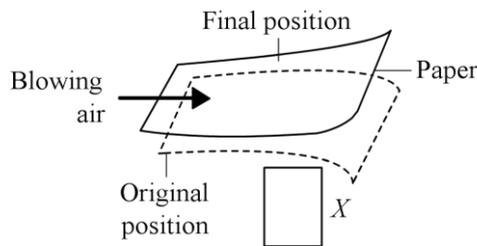

Diagram 5.2

(a) Compare the position of the paper in Diagram 5.1 and Diagram 5.2.

_____

[1 mark]

(b) *F* is a force that causes the paper to change its position.
Indicate and label the direction of *F* in the box *X*.

_____

[1 mark]

(c) Explain how *F* is produced.

_____
_____
_____

[2 marks]

(d) (i) Based on Diagram 5.2, state what will happen to the position of the paper when the air is blown
faster?

_____

[1 mark]

(ii) Give **one** reason for your answer in (d)(i).

_____

[1 mark]

5

(e) Name the physics principle involved.

_____

(f) Name **one** piece of apparatus in a school laboratory which uses the principle in (e).

_____

[1 mark]

7   Diagram 6.1 shows a light ray is directed into a glass prism. The light ray after passing point O is not shown.
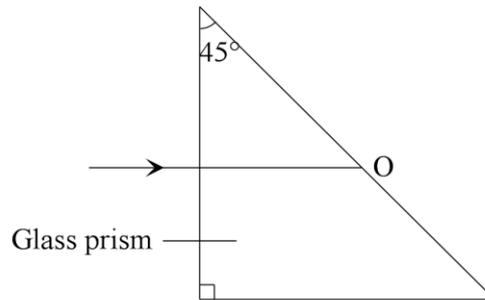

Diagram 6.1

The refractive index of the glass prism is 1.6.
(a) (i) Calculate the critical angle of the glass prism.

[2 marks]

(ii) On Diagram 6.1, complete the light ray path from point O.

[2 marks]

(iii) Based on the answer in (a)(ii), name the light phenomenon involved.

_____

[1 mark]

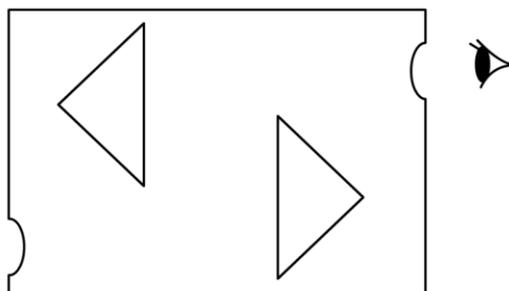(b) Diagram 6.2 shows the position of two prisms on one side of the binoculars.

Diagram 6.2

On Diagram 6.2, draw the ray path entering both prisms.

[2 marks]

(c) Objective lens is used in the binoculars to see the object clearer.
   Table 2 shows the characteristics of four lenses.

Lens	Focal length (cm)	Diameter of the lens
P	1.0	Small
Q	10.0	Big
R	50.0	Small
S	100.0	Big

Table 2

Based on Table 2, state the suitable characteristics of the lens to be used as the objective lens.
Give **one** reason for the suitable characteristics.
(i) Focal length of the lens:

_____

Reason:

_____
[2 marks]

(ii) Diameter of the lens:

_____

Reason:

_____
[2 marks]

(d) Based on the answers in (c)(i) and (c)(ii), choose the most suitable lens to be used as the objective lens.

_____
[1 mark]

8   Diagram 7.1 shows one bulb connected to a 9V dry cell.

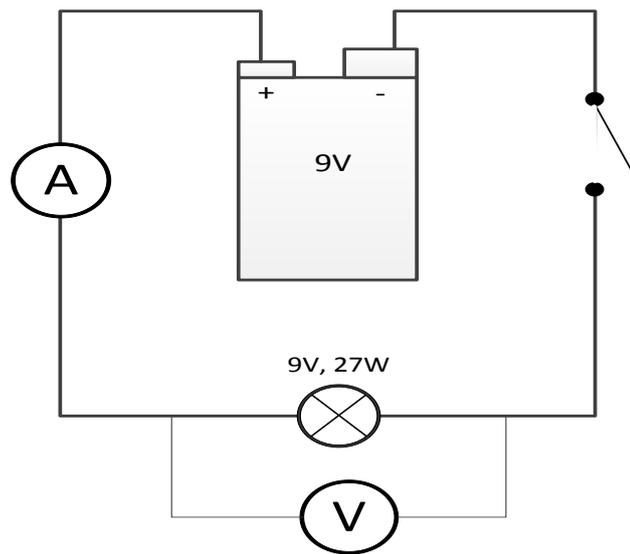**Diagram 7.1**

(a) What is meant by the label "9V, 27W" on the bulb

_____

[1 mark]

(b)   Based on Diagram 7.1, calculate

   (i)   The reading of the ammeter   [1 mark]

   (ii)   The resistance of the cold filament   [2 marks]

(c)   Table 3 shows three different types of filament to be used in bulb in Diagram 7.1
       above.

Filament	Power Supplied to the bulb	Power produced (Light)
P	20 Js^{-1}	15 Js^{-1}
Q	30 Js^{-1}	28 Js^{-1}
R	50 Js^{-1}	43 Js^{-1}

Table 3

   (i) State the effect of thickness of wire of the filament to the rate of energy loss in
       the filament.

   _____
   _____
   [1 mark]

   (ii) Calculate the efficiency of each filament P, Q and R

Filament	Efficiency Calculation	Suitability (Yes/No)
P		
Q		
R		

[3 marks]

(iii) If 2 bulbs of the same power ratings of "9V, 27W" are connected in series to the same power supply as shown in Diagram 8.2, calculate the power output of each lamp A and B. State the brightness of each lamp in terms of its percentage with respect to its normal brightness.
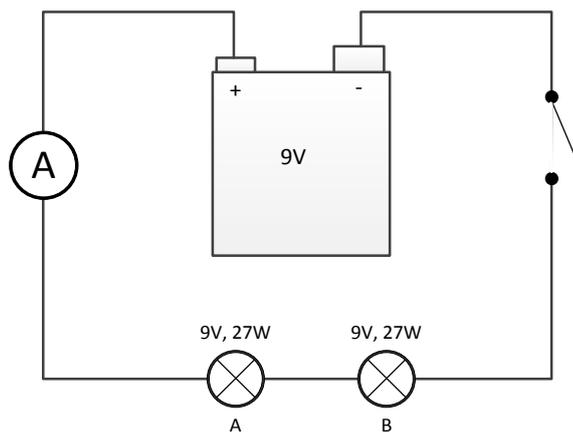

Diagram 7.2

Bulb	Power	% Brightness
A		
B		

[2 marks]

(iv) State what is the effect on the bulb when the main battery of 9V is replaced with a battery of 6V

Observation	Effect
Brightness	
Current	
Bulb life span	

[2 marks]

9   Diagram 9.1 and Diagram 9.2 show the light rays from two identical objects passing through the convex lenses, *X* and *Y*. Both the lenses produce real images. *F* is the focal point for each lens.
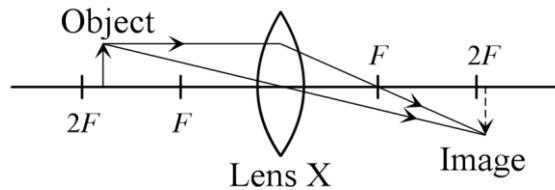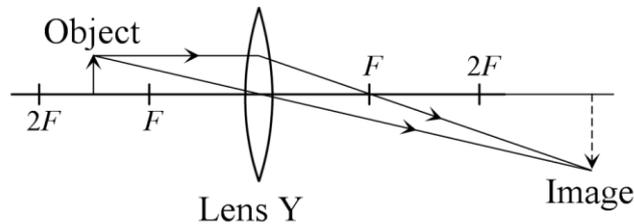

Diagram 9.1

Diagram 9.2

(a) (i) What is meant by focal point?

[1 mark]

   (ii) Based on Diagram 9.1 and Diagram 9.2, compare the thickness of the lenses, the focal length and the size of image produced by lenses *X* and *Y*.

[5 marks]

(b) Explain why a piece of paper burns when it is placed under a convex lens aimed towards hot sun rays.

[4 marks]

(c) You are given two convex lenses, *S* and *T*, with focal lengths 10 cm and 5 cm respectively. Both the lenses are used to build a simple compound microscope at normal adjustment.
   (i) Using the two lenses, explain how you are going to build the simple compound microscope.

[6 marks]

   (ii) Suggest modifications that need to be done on the microscope to produce clearer and bigger image.

[4 marks]

10 Diagram 10.1 shows a ping pong ball coated with metal paint, oscillating between two metal plates P and Q.
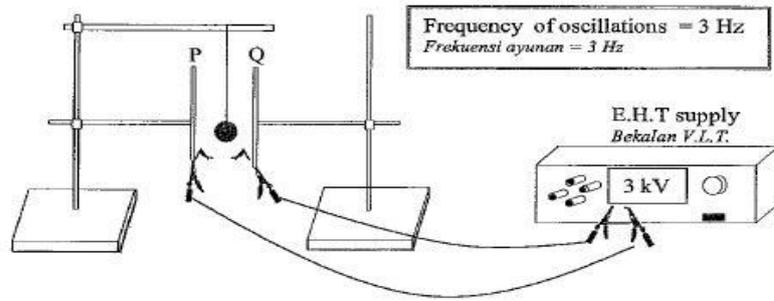

Diagram 10.1

Diagram 10.2 shows the ping pong ball oscillating between the plates P and Q when the distance between P and Q is increased.

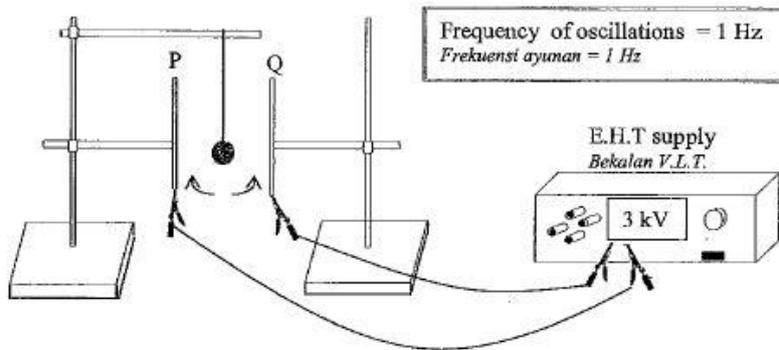**Diagram 10.2**

(a) (i) What is the meaning of electric field?   [1 mark]

   (ii) Using Diagram 10.1 and Diagram 10.2, compare the voltage between the plates P and Q, the distance between the plates P and Q and the frequency of oscillations of the ping pong ball. Relate the distance between the plates P and Q with the frequency of oscillations of the ping pong ball to make a deduction regarding the relationship between the distance between the plates and the strength of the electric field.   [5 marks]
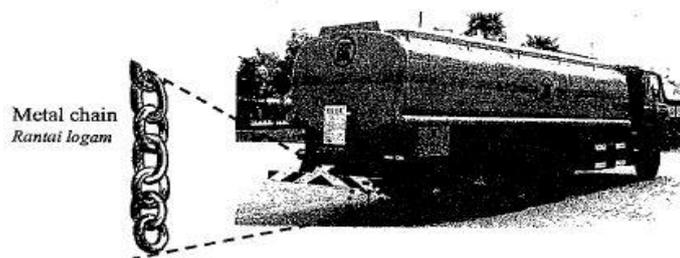
(b) Diagram 10.3 shows a petrol tanker.

Diagram 10.3

   Explain why the petrol tanker has a metal chain on its underside.   [4 marks]

(c) An apartment building is going to built in an open space. As an electrical engineer, you have to make sure the building is safe for occupation.

Suggest suitable features needed in the building design for the following aspects :

   (i)   wiring system

   (ii)   Lightning protection

   (iii)   Safety of electrical appliances when used in the building

   (iv)   Energy efficiency in electrical usage   [10 marks]
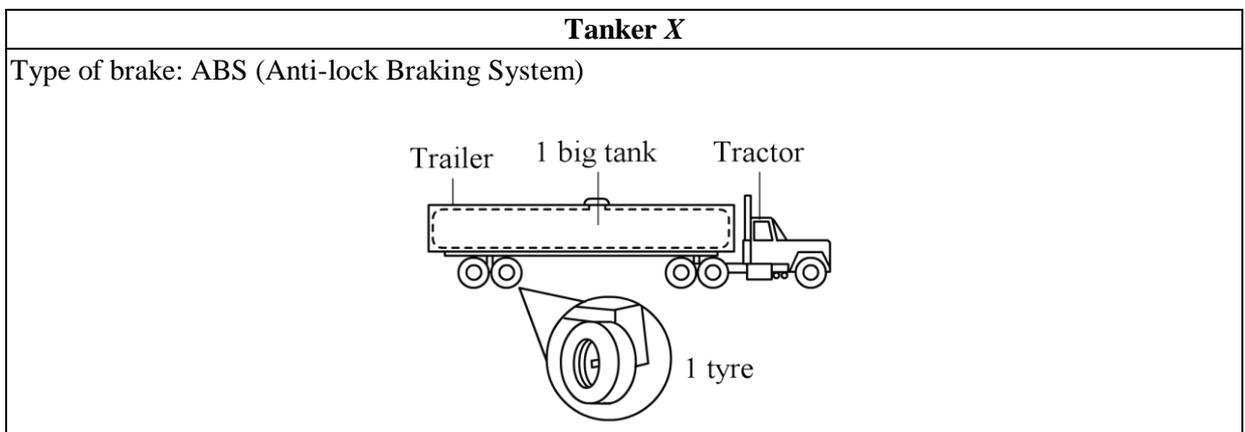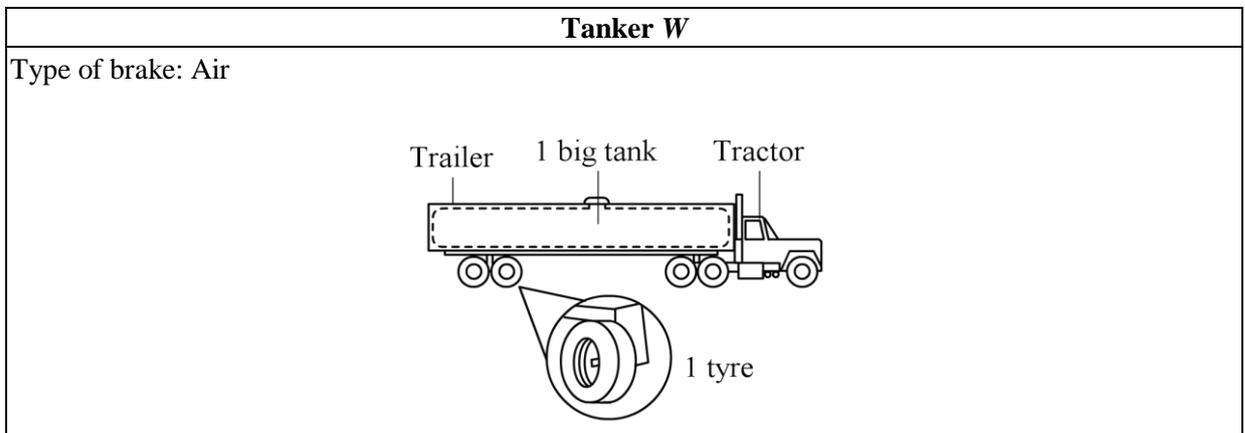
11

[20 marks]
Answer any **one** question from this section

11 Diagram 11.1 shows the speed limit and load limit of heavy vehicles such as buses and lorries.

Diagram 11.1

(a) What is meant by speed?

[1 mark]

(b) Using the concepts of momentum and inertia, explain why the speed limit and the load limit must be imposed on heavy vehicles.

[4 marks]

(c) Diagram 11.2 shows four tankers, *W*, *X*, *Y* and *Z*, with different specifications.

Tanker *W*
Type of brake: Air

Tanker *X*
Type of brake: ABS (Anti-lock Braking System)

12

Tanker Y
Type of brake: Air

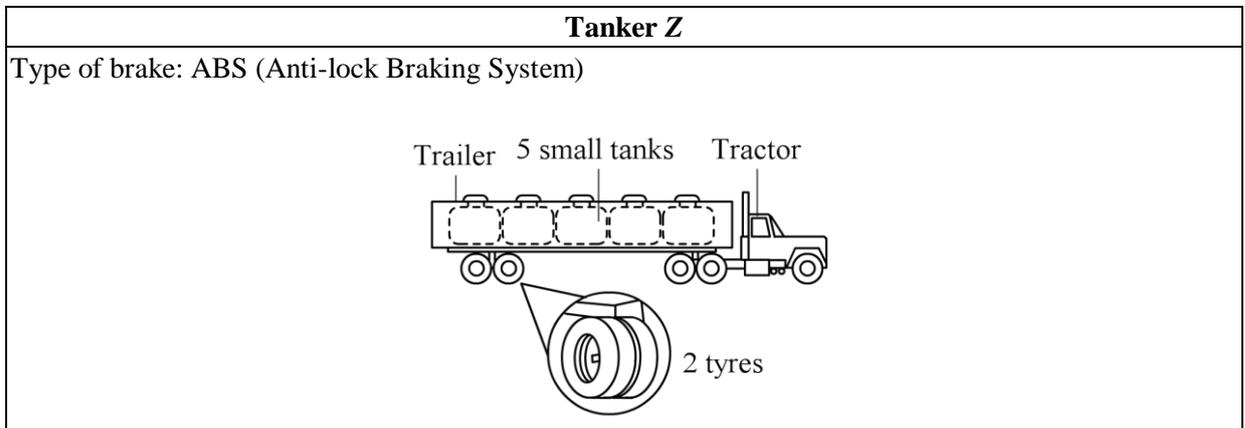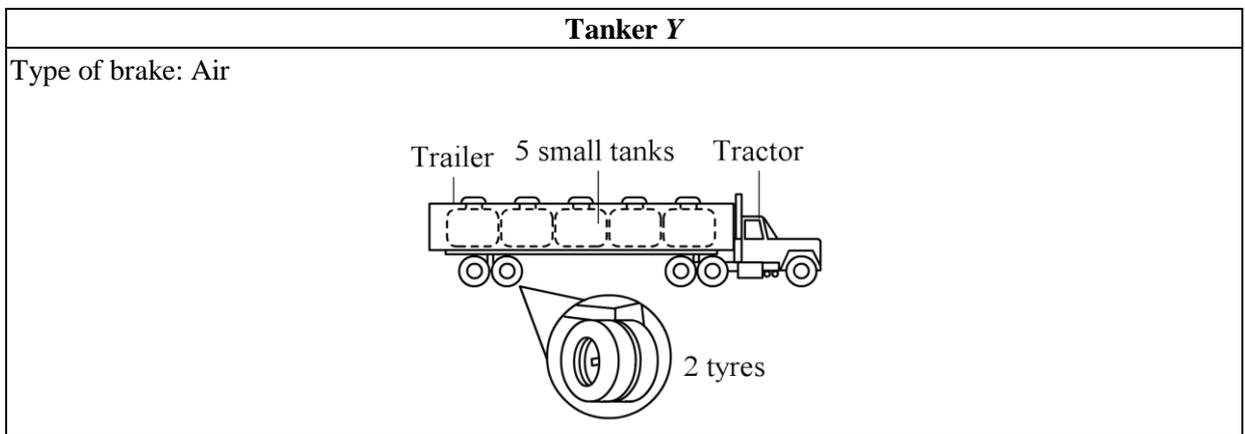| Tanker Z |
|---|
| Type of brake: ABS (Anti-lock Braking System) |

Diagram 11.2

Study the specifications of all the four tankers from the following aspects:
- The type of brakes
- The number of tyres
- The number and size of the tanks
- The distance between the trailer and the tractor

Explain the suitability of the aspects.

Determine the most suitable tanker to deliver oil safety. Justify your choice.

[10 marks]

(d) A tanker of mass 1 970 kg accelerates from rest to a velocity of 47 km h^{-1} in 12 s.
  (i) Calculate the acceleration of the tanker.
  (ii) Calculate the force acting on the tanker.

[5 marks]

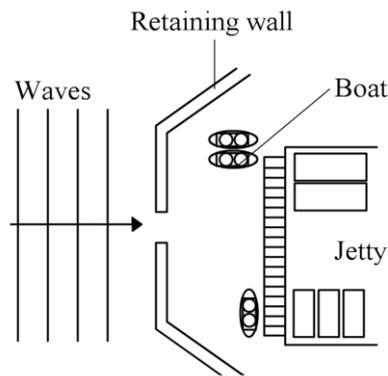**12** Diagram 12.1 shows waves moving towards a jetty.

Diagram 12.1

(a) (i) What is the meaning of diffraction?

[1 mark]

(ii) Draw the wave pattern of the waves after passing through a gap in the between of two retaining walls.

[1 mark]

(b) The gap is made wider to allow more boats to enter the jetty.
State the effect on
(i) the waves passing through the gap.

[2 marks]

(ii) the jetty.

[1 mark]

(c) Diagram 12.2 shows the wave pattern is produced at the gaps after jetty is modified to ease the sea traffic congestion.

Boats M and N are located in the jetty. Boat M is place in the nodal line where as boat N is placed in the antinodal line.
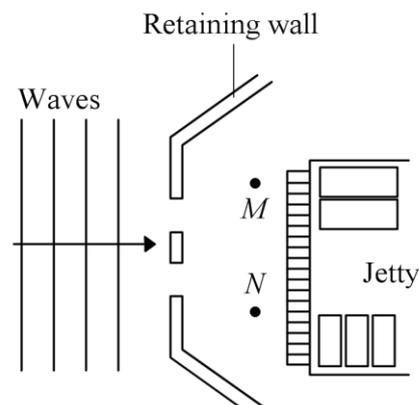

Diagram 12.2

(i) The wave pattern formed is caused by the superposition of waves from two coherent sources.
What is the meaning of coherent sources?

[1 mark]

(ii) Describe the movement of two similar boats that are located at *M* and *N*.
Explain your answer.

[4 marks]

14

(d) You are required to build a new jetty at a new location.
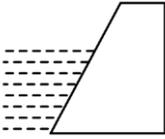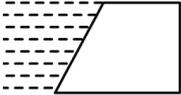Table 4 shows the location and the characteristics of four retaining walls.

Type of retaining wall	Location of retaining wall	Structure of retaining wall	Surface of retaining wall	Height of retaining wall
P	Bay	Sloping retaining wall	Uneven surface	High
Q	Cape	Sloping retaining wall	Uneven surface	Low
R	Bay	Vertical retaining wall	Smooth surface	High
S	Cape	Vertical retaining wall	Smooth surface	Low
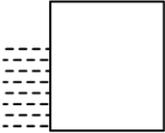
Table 4

Explain the suitability of each characteristic and then determine the most suitable retaining wall. Give reasons for your choice.

[10 marks]

The following information may be useful. The symbols have their usual meaning.

1. $a = \dfrac{v \,|\, u}{t}$

2. $v^2 = u^2 + 2as$

3. $s = ut + \frac{1}{2}\,at^2$

4. Momentum $= mv$

5. $F = ma$

6. Kinetic energy $= \frac{1}{2}\,mv^2$

7. Gravitational potential energy $= mgh$

8. Elastic potential energy $= \frac{1}{2}\,Fx$

9. $\rho = \dfrac{m}{v}$

10. Pressure, $P = h\rho g$

11. Pressure, $P = \dfrac{F}{A}$

12. Heat, $Q = mc\theta$

13. $\dfrac{PV}{T} = $ Constant

14. $E = mc^2$

15. $v = f\lambda$

16. Power, $P = \dfrac{energy}{time}$

17. $V = IR$

18. Power, $P = IV$

19. $\dfrac{N_s}{N_p} = \dfrac{V_s}{V_p}$

20. Efficiency $= \dfrac{I_s V_s}{I_p V_p} \times 100$

21. $\dfrac{1}{f} = \dfrac{1}{u} + \dfrac{1}{v}$

22. $n = \dfrac{\sin i}{\sin r}$

23. $n = \dfrac{real\ depth}{apparent\ depth}$

24. $\lambda = \dfrac{ax}{D}$

25. $Q = It$

26. $E = I(R + r)$

27. $eV = \frac{1}{2}\,mv^2$

28. $\dfrac{V}{V_T} = \dfrac{R}{R_T}$

29. $G = 10\ ms^{-2}$

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No. of Candidates   : 278   Verified by : Pn Lew Poh Peng
No. of printed pages : 16   (Head of Science & Maths Department)
                                Verified by   : Pn Ean Yong Moon
                                     (Senior Assistant for Administration)

Name :_____
Class : _____

Answer: SECTION A

1 (a) (i) 0.01 cm
        (ii) 0.32 cm
     (b) (i) -0.02 mm
        (ii) 1.51 mm

2 (a) Reflection of light
     (b) Real
     (c)
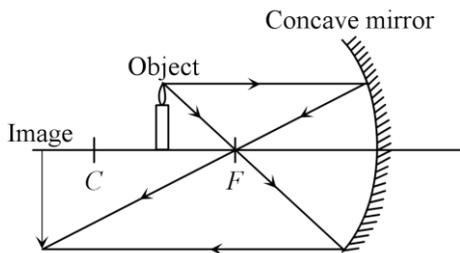
3 (a) longitudinal
     (b) Because constructive interference takes place
     (c) $\lambda = \dfrac{ax}{D}$

     $\lambda = \dfrac{-0.2 \times 3.5}{2.2}$

     $\lambda = -0.318$ m
     (d) (i) The distance between consecutive loud sounds decreases
        (ii) Wavelength decreases when the frequency of the sound wave increases

4 (a) Latent heat of fusion
     (b) Heat loss is needed to strengthen the bonds between the molecules.
     (c) 420 000 J
     (d)

17
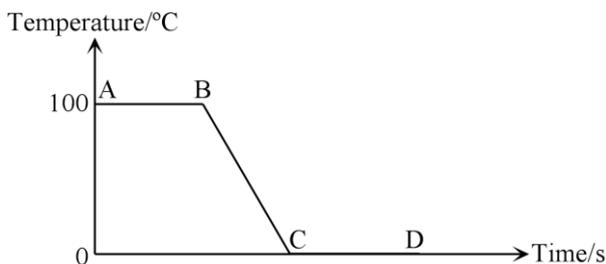
5 (a) The amount of heat required to raise the temperature of 1 kg of a substance by 1°C or 1°K.

    (b) (i) Silver.

        Silver has low specific heat capacity.

      (ii) Lower mass.

        It is easy to handle.

    (c) (i) 99.7 s

      (ii) 73.7 s

      (iii) 211.7 s

    (d) Silver pan

6 (a) The position of the paper in Diagram 5.2 is higher than in Diagram 5.1.

    (b)
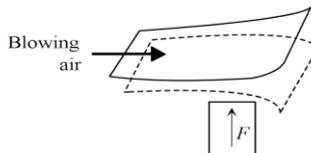
    (c) The air above the paper flows with high speed and creates a region of low pressure. The higher atmospheric pressure below the paper produces a resultant upward force, F

    (d) (i) The paper will move further upwards

      (ii) The difference in pressure increases and produces a greater force

    (e) Bernoulli's principle

    (f) Bunsen burner

7 (a) (i) Critical angle is c and refractive index is n,

$$n = \frac{1}{\sin c}$$

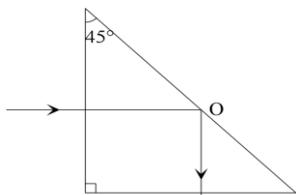$$1.6 = \frac{1}{\sin c}$$

$$\sin c = \frac{1}{1.6} = 0.625$$
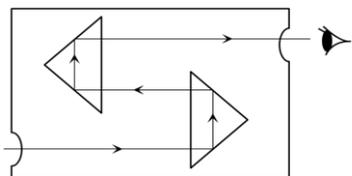
$$c = 38.68°$$

      (ii)

      (iii) Total internal reflection

    (b)

    (c) (i) Focal length of the lens:

        A longer focal length

        Reason:

        Gives a higher magnification

      (ii) Diameter of the lens:

        A lens with a bigger diameter

   Reason:

        Produces brighter image

    (d) S

8 (a)	When the bulbs is connected to the power source of 9V, the energy of 27 J is produced in 1 second			1
(b) (i)	Ammeter Reading P= IV ➔ I = P/V =27/9 = 3 Amp			1
b (ii)	Resistance of cold filament P= V^2/R ➔ R = V^2/P ➔ $(9)^2$/27 = 3 Ω *This method is independent of the answer in (b) (i). If formula is right can award 1 mark.* or V = IR ➔ R = V/I ➔ 9/3 = 3Ω *This method must make sure b (i) is correct. If b (i) is wrong, no marks using this method. No marks for formula*			2
(c) (i)	As the thickness of the wire increases, the rate of energy loss in the filament reduces			1
(ii)	Efficiency = Energy Output / Energy Input x 100% Efficiency of P = 15/20 x 100 % = 75.00%. **No** Efficiency of Q = 28/30 x 100 % = 93.33% **Yes** ✓ Efficiency of R = 43/50 x 100 % = 86.00 % **No**			3
(iii)	Total Resistance of Bulb in series is 6Ω. Current in Circuit : I = V/R = 9/6 = 1.5A Power produced by Bulb A: P = i^2R = $(1.5)^2$ x 3 = 6.75W : **25%** Power produced by Bulb B: P = i^2R = $(1.5)^2$ x 3 = 6.75W : **25%**		1 1	
(iv)	**Observation:** Brightness: Reduced Current : Reduced Bulb Life span: Will increase	*Only all correct then full mark. If 2 right, 1 mark award. 1 right. No marks.*	2	
			TOTAL	**12**

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Answer: SECTION B

9 (a) (i) A point where rays parallel to the principal axis converge at or diverge from
  (ii) • Lens *X* is thicker than lens *Y*
    • The focal length of lens *Y* is longer than that of lens *X*
    • The size of the image produced by lens *Y* is bigger than that produced by lens *X*
    • When the power of a lens increases, its focal length decreases
    • When the focal length increases, the size of the image increases

  (b) • Light rays from the hot sun which travel in parallel pass through the convex lens
    • Light rays are focused and converged onto the focal point of the lens after the light rays passing through the lens
    • At the point, the intensity of lights is large and the light energy causes an increase in temperature. The paper starts to burn after the spot on the paper becomes hot enough

  (c) (i) • *S* is used as the eyepiece
    • *T* is used as the objective lens
    • *S* and *T* are in line
    • The total distance between the lenses is more than (10 + 5) cm
    • An object is placed between f_o and $2f_o$ [f_o = Focal length of objective lens]
    • The first image, I_1 formed by objective lens is real, inverted and magnified
    • I_1 then acts as the object for the eyepiece and the final image, I_2 formed is virtual, inverted and magnified

  (ii) To produce **clearer image**:
  Increase the diameter of the objective lens
  To produce **bigger image**:
  Decrease the focal length of the objective lens

10	(a)	(i)	Electric field is a region in which an electric charge experiences a force
		(ii)	-The voltage between the plates in 10.1 is equal with 10.2 -The distance between P and Q in 10.1 is shorter // smaller than 10.2 -The frequency in 10.1 is greater // higher than in 10.2 -The longer the distance the higher the frequency -The longer the distance between the plates, the higher the strength of the electric field
	(b)		-Friction between the tanker and air molecules -Produces electrostatic charge on the tanker body -The charge on the tanker body is neutralized // discharged by the surrounding air via the metal chain -No danger of electric sparks which can cause fire during loading or unloading of fuel // petrol

(c)

Suitable feature	Explanation
Use parallel circuit	The bulbs can switched on and off individually // separately
Lightning conductor	Transfer lightning charges to the ground // earth
Fuse	Melts when short circuit occurs
Circuit breaker	Switches off current when overloaded
Separate circuit for heavy duty & frequently used appliances	To protect electrical appliances from damage
Solar panel	Less electrical usage // solar power converted to electrical energy
Thermostat	Automatic switch to respond to temperature changes
Sensors	Switches off electrical appliances when not in use

Answer: SECTION C

11 (a) Speed is the distance travelled per unit time

(b) Using the concepts of momentum and inertia, explain why the speed limit and the load limit must be imposed on heavy vehicles.
- Speed limit is imposed because:
  Momentum depends on mass and velocity. The momentum of a vehicle is high when it travels in high velocity. A high momentum will cause a high impulsive force during a collision
- Load limit is imposed because:
  Inertia depends on mass. The inertia of a vehicle is high when it carries more load. It is difficult to stop a moving vehicle which is carrying a big load

(c) (i) The type of brakes:
  ABS is more effective than air brake - lorry can be stopped immediately without skidding
  (ii) The number of tyres:
  Two tyres are better than one tyre - provides better support
  (iii) The number and size of tanks:
  5 small tanks are better than 1 big tank - 5 small tanks will have smaller inertia compare with 1 big tank - reduces the inertial impact on each tank if the tanker stop suddenly
  (iv) The distance between trailer and tractor:
  Further distance is better - to prevent collision between the trailer and the tractor
  (v) Tanker **Z** is the most suitable because use ABS, 2 tyres, 5 small tanks and the distance between trailer and tractor are further

(d) (i) $v = \dfrac{47 \times 10^3}{3600}$

$v = 13.056 \text{ m s}^{-1}$

$v = u + at$

$13.056 = 0 + a(12)$

$a = 1.088 \text{ m s}^{-2}$

(ii) $F = ma$

$F = 1\,970 \times 1.088 = 2\,143.29 \text{ N}$

12 (a) (i) Diffraction of waves is a phenomenon where the waves spread out as the waves pass through an aperture or round an obstacle

(ii)
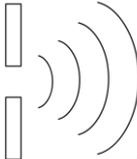
(b) (i) • Less diffraction
  • Wave energy increases
  (ii) Damage to the jetty increases or soil erosion increases

(c) (i) Coherent sources are sources that produce waves of the same frequency, same amplitude and are in phase
  (ii) • The boat does not move at location *M*
  • Destruction interference occurs at *M*
  • The boat moves up and down with high amplitude at location *N*
  • Constructive interference occurs at *N*

(d) • The jetty should be located at the bay because the bay is calmer and has smaller amplitude waves
  • Sloping retaining wall should be used because the speed or wavelength of the water wave decreases when the depth decreases
  • Uneven surface of retaining wall should be used to reduce the energy of the water waves
  • The retaining wall should be high to protect jetty from high waves
  P is chosen because it is located at a bay, has sloping, uneven surface and high retaining wall