O

GAN ENG SENG SCHOOL
Preliminary 1 Examination 2014

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PHYSICS
Paper 1 Multiple Choice

5059/01

07 May 2014
1 hour

Sec 4 Express

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.

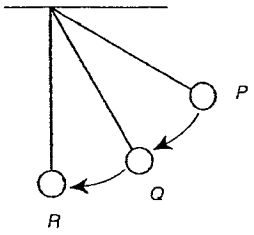
Any rough working should be done in this booklet.

Total Marks
/40

1 Which of the following about the derived unit and its corresponding name is not correct?

	Derived unit	Name
A	N m	Joule
B	$N\ m^{-2}$	Pascal
C	$J\ s^{-1}$	Watt
D	$W\ A^{-1}$	Ohm

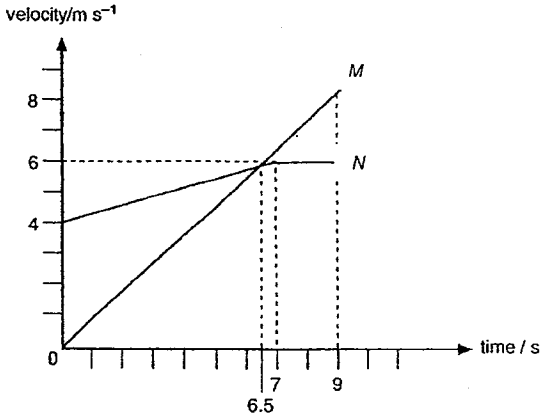
2 A pendulum is released from *P*. It takes 0.2 s to swing from *P* to *Q* and another 0.2 s from *Q* to *R*. The pendulum is at its lowest point at *R*.



What is the frequency of the pendulum?

A 0.63 Hz **B** 1.30 Hz **C** 1.60 Hz **D** 2.00 Hz

3 The velocity-time graph below shows the motion of two cars *M* and *N*.



Which of the following statements correctly describes the motion of both cars?

A Cars *M* and *N* meet each other at 0 s and 6.5 s.

B Initially, car *N* is faster than car *M*. After 7 s, *N* stops moving while *M* continues to move on.

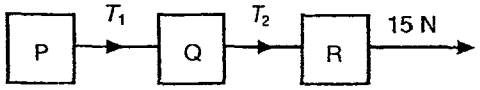
C Initially car *N* is leading. After 6.5 s, car *M* is leading.

D Throughout the 9 s interval, car *N* is leading.

4 A spacecraft is descending to the Moon's surface at a steady velocity of 2.0 m s^{-1}. At a height of 4.0 m, the engines are cut off and it falls freely to the surface. Taking the Moon's gravitational field strength to be 1.6 m s^{-2}, at what velocity does it strike the Moon?

A 3.6 m s^{-1} B 4.1 m s^{-1} C 12.8 m s^{-1} D 14.8 m s^{-1}

5 P, Q and R are three identical blocks resting on a smooth surface. A force of 15 N is applied at one end as shown in the diagram below.

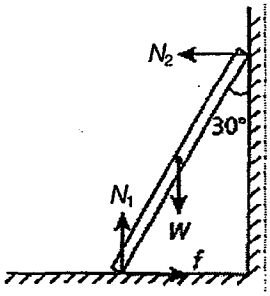


What are the tensions T_1, between blocks P and Q, and T_2, between blocks Q and R, in the strings?

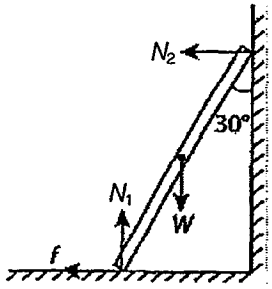
	T_1 / N	T_2 / N
A	15	15
B	5	10
C	10	5
D	7.5	7.5

6 A stationary uniform ladder of length 6 m and mass 20 kg is leaning against a smooth vertical wall on rough ground. The ladder makes an angle of 30 ° with the vertical. Which of the following diagrams correctly shows the forces acting on the ladder?

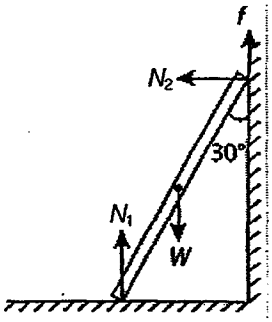
A



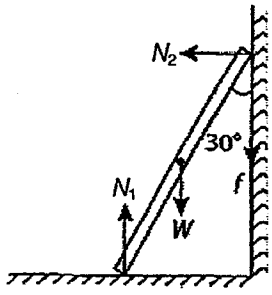
B



C



D



7 Which of the following statements is true about inertia?

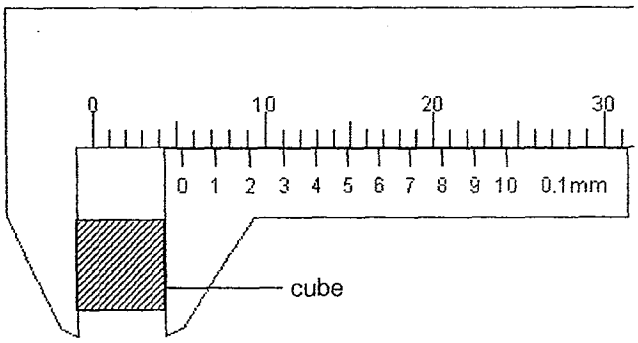
A Newton's Second Law of Motion describes inertia.

B Objects with less mass have more inertia.

C Inertia prevents a moving object with no external force from slowing down.

D Inertia causes a moving object to decelerate.

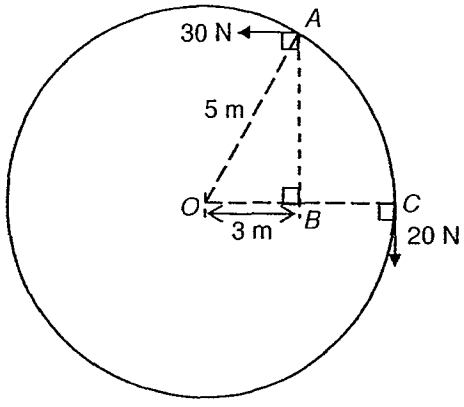
8 The diagram below shows a cube being measured with a vernier calipers.



The cube has a mass of 0.40 g. What is its density?

A 2.7 g cm^{-3} **B** 3.2 g cm^{-3} **C** 5.0 g cm^{-3} **D** 60 g cm^{-3}

9 The diagram below shows two forces acting on a circular disc at points *A* and *C*. Point *O* is the centre of the disc.

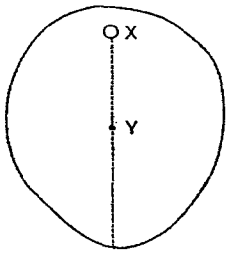


What is the net moment experienced by the disc about its centre?

A 10 N m clockwise **B** 20 N m anticlockwise

C 50 N m anticlockwise **D** 90 N m anticlockwise

10 The diagram below shows an irregularly-shaped flat paper sheet freely pivoted at *X* on a horizontal pivot so that the plane of the sheet is vertical. The centre of gravity of the sheet is marked *Y*.



Which one of the following best explains why *Y* is vertically below *X*?

A The centre of gravity is always lower than point *X*.

B The turning effect of forces will be the greatest.

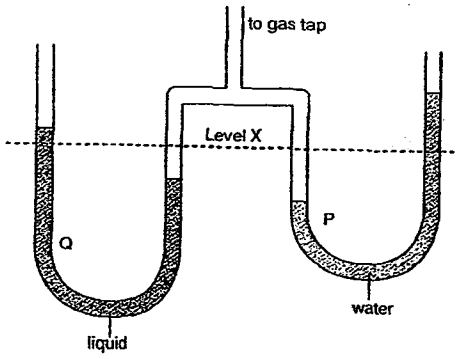
C The weight of the sheet can be reduced so that it can be in equilibrium.

D There will be no turning effect so that the sheet can stay in equilibrium.

11 The mass of a car is 1 200 kg. If the total area of contact between the four tyres and the road surface is 30 cm^2, what is the pressure exerted by each tyre on the road surface?

A 1:00 MPa **B** 2.50 MPa **C** 3.20 MPa **D** 4.00 MPa

12 The apparatus shown below is connected to a gas tap in order to measure the pressure of gas. The tube *P* contains water and the tube *Q* contains some other liquid, the liquid levels in the tubes being originally at *X*.



When the gas is turned on, the water in the open limb of *P* rises to a higher level than that of the liquid in the open limb of *Q* as shown in the above diagram. This is because ..... .

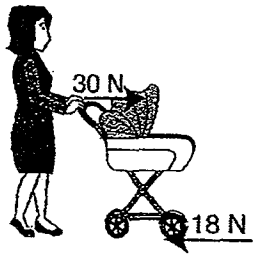
A the liquid in *Q* is denser than water

B tube *P* is closer to the gas tap than tube *Q*

C there is more liquid in tube *Q* than in tube *P*

D the pressure of the gas exerted on *P* is higher than that exerted on *Q*

13 A mother pushes a pram for a distance of 5 m with a horizontal force of 30 N. The friction on the pram is 18 N.



What is the work done by the mother?

A 60 J **B** 90 J **C** 150 J **D** 210 J

14 On braking, 500 kJ of thermal energy were produced when a vehicle of total mass 1 600 kg was brought to rest on a level road. The speed of the vehicle just before the brakes were applied was ..... .

A 0.62 m s^{-1} **B** 0.79 m s^{-1} **C** 25 m s^{-1} **D** 62.5 m s^{-1}

15 Brownian motion is often demonstrated by viewing illuminated smoke particles, contained in a sealed transparent cell, through a low power microscope. Which of the following statements is not correct?

A Small specks of light are seen to move about in a random motion.

B The illumination enables the observer to see the actual molecules.

C The observed motion is caused by random motion of the air molecules.

D The speed of the observed motion would increase if temperature rose.

16 When air is pumped into a bicycle tyre at a constant temperature, the pressure increases because..... .

A more molecules are hitting the tyre

B the molecules are closer together

C the molecules are moving faster

D the molecules have more kinetic energy

17 Which of the following physical properties can be used to measure temperature?

I pressure of a fixed mass of gas at constant volume

II resistance of a wire

III volume of a fixed mass of gas at constant pressure

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

18 The following information shows the length of the mercury column in a thermometer at various conditions at normal room temperature and pressure.

In pure melting ice : 6 cm

In pure boiling water : 22 cm

In a solution : 14 cm

What is the temperature of the solution?

A 50 °C **B** 65 °C **C** 80 °C **D** 200 °C

19 Which of the following best explains why a thin water-filled paper cup held in a flame will not catch fire?

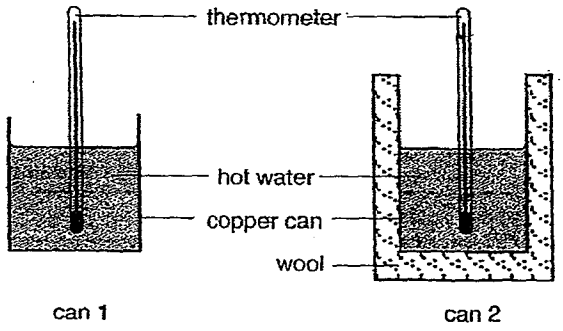
A Heat flows to the surroundings quickly through convection.

B The inside of the paper is wet.

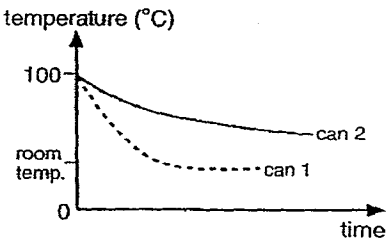
C The paper cup cannot become hotter than the water it contains.

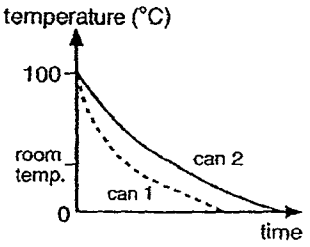
D The paper is a poor conductor of heat.

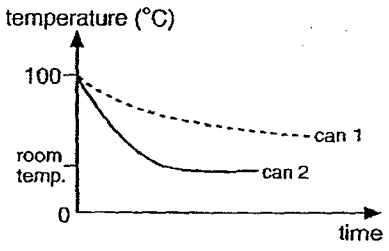
20 Two copper cans are filled with boiling water as shown below. One can is insulated with wool. The temperature of the water in each can is taken every minute.

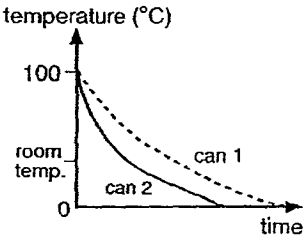


Which graph shows the results obtained?

A


B


C


D


21 Perspiring helps to cool the body because ..... .

A the temperature of the sweat is lower than the body temperature

B heat is absorbed from the body when sweat evaporates

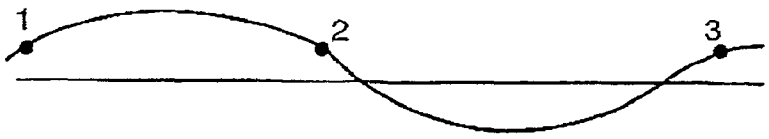
C heat is removed when sweat comes out of the body

D the body loses heat to produce sweat

22 An immersion heater is used to heat a cup of water. It takes 10 minutes to bring the water from 20 °C to 100 °C. What is the time taken for the heater to vaporise the boiling water completely? (specific heat capacity of water = 4 200 J kg^{-1} K^{-1} and specific latent heat of vaporisation of water = 2.268 × 10^6 J kg^{-1})

A 54 minutes B 60 minutes C 67.5 minutes D 77.5 minutes

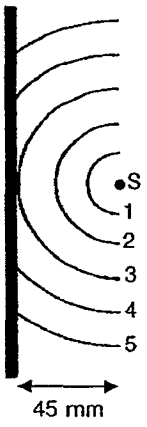
23 The diagram below shows the position of a string at a particular instant of time as a transverse wave travels along it from left to right.



Which one of the following correctly shows the direction of the velocities of the points 1, 2 and 3 on the string?

	1	2	3
A	→	→	→
B	→	←	→
C	↓	↓	↓
D	↓	↑	↓

24 A vibrating source *S* produces circular water waves near a straight reflector as shown in the diagram below.



If the speed is 60 mm s^{-1}, what is the wavelength and frequency of the waves?

	wavelength / mm	frequency / Hz
A	15	4
B	15	40
C	22.5	2.6
D	22.5	26

25 Which of the following is not a possible mirror image of the letter *F*?

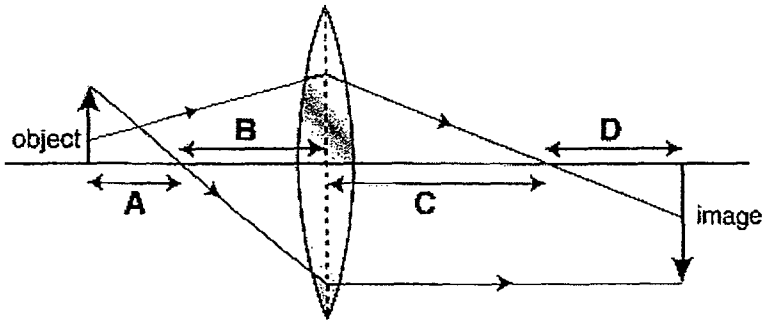
A 

B 

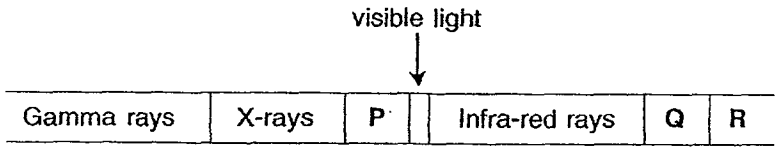
C 

D 

26 An object is placed in front of a converging lens as shown in the diagram below. Which of the distances is equal to the focal length of the lens?



27 The chart below shows the main parts of the electromagnetic spectrum.



What are the types of radiation represented by **P**, **Q** and **R** in the chart?

	P	Q	R
A	Radio waves	Ultra-violet rays	Microwaves
B	Radio waves	Microwaves	Ultra-violet rays
C	Ultra-violet rays	Radio waves	Microwaves
D	Ultra-violet rays	Microwaves	Radio waves

28 Which of the following regarding sound waves and electromagnetic waves is/are correct?

I The frequency of a sound wave is less than the frequency of all electromagnetic waves.

II The speed of a sound wave is slower than the speed of all electromagnetic waves.

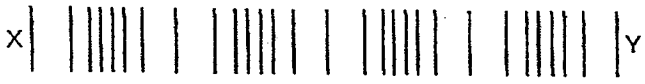
III The wavelength of a sound wave is longer than the wavelength of all electromagnetic waves.

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

29 A tuning fork produces a sound wave with a frequency of 1 000 Hz. If the speed of sound is 340 m s^{-1} in air, what is the distance between the centre of a rarefaction and the centre of an adjacent compression on the wave?

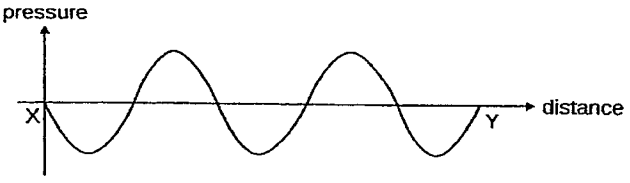
A 0.085 m **B** 0.17 m **C** 0.34 m **D** 2.9 m

30 The diagram below shows the positions of the air particles, represented by straight lines, at a particular instant from *X* to *Y*.

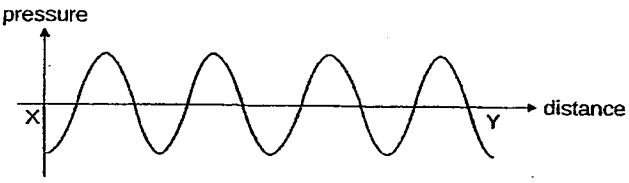


Which graph correctly depicts the pressure variation with respect to distance?

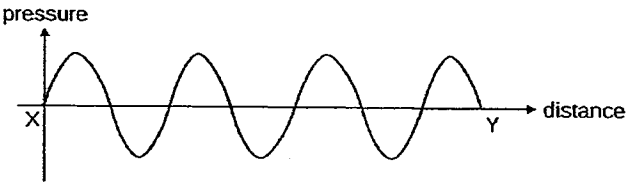
A



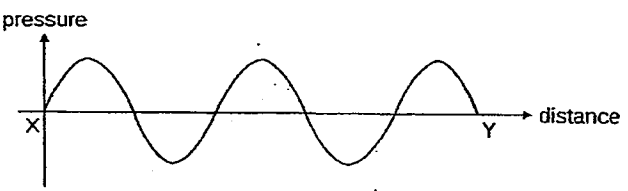
B



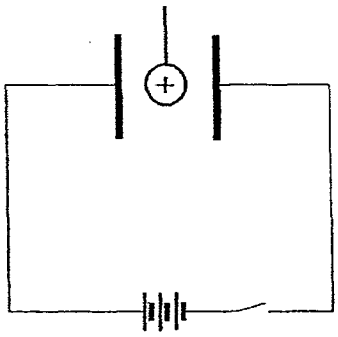
C



D



31 A positively charged metal sphere suspended by an insulating thread is placed between two metal plates connected to a battery as shown in the diagram below.



What is the subsequent motion of the sphere when the switch is closed?

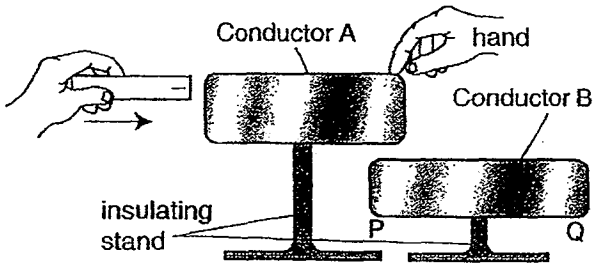
A Move out of the paper

B Move into the paper

C Move to the right

D Move to the left

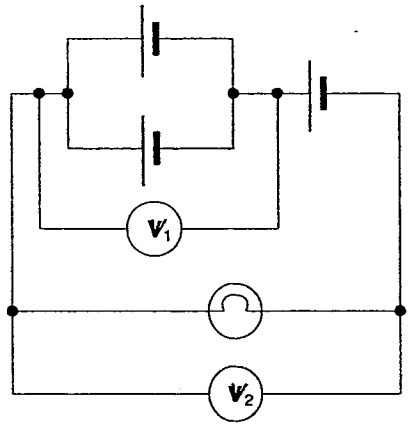
32 A negatively-charged rod is brought near a conductor *A* which is placed on an insulating stand. A student touches conductor *A* momentarily at one end as shown in the diagram below.



What are the resulting charges on conductor *B* at *P* and *Q* after both the hand and then the negatively-charged rod are removed?

	P	*Q*
A	Positive	Positive
B	Positive	Negative
C	Negative	Positive
D	Negative	Negative

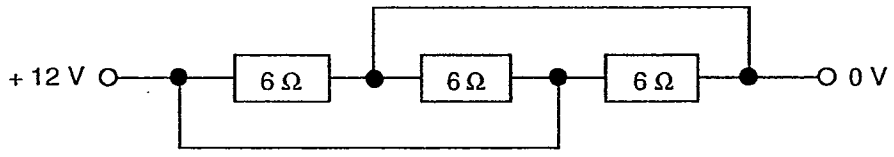
33 The diagram below shows three cells, each of 1.5 V, arranged in a circuit with a bulb and two voltmeters.



What are the values of V_1 and V_2 and how much energy is involved if 48 C of charge flows through the bulb?

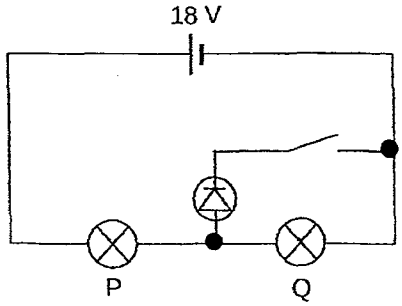
	V_1 / V	V_2 / V	energy / J
A	0	1.5	32
B	0	3.0	16
C	1.5	1.5	72
D	1.5	3.0	144

34 What is the total resistance of the circuit as shown in the diagram below?



A 0.67 Ω **B** 2.0 Ω **C** 18 Ω **D** 216 Ω

35 The diagram below shows two identical bulbs *P* and *Q*. They have the same brightness when the switch is opened.



What will happen when the switch is closed?

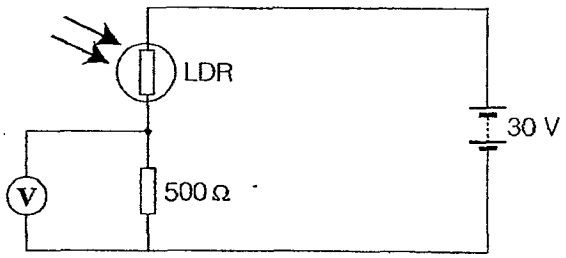
A No change in the brightness of *P* and *Q*.

B Both *P* and *Q* light off.

C *P* is brighter and *Q* lights off.

D *P* is dimmer than *Q*.

36 A light dependent resistor (LDR) and a 500 Ω resistor is connected across a 30 V source as shown in the diagram below. The resistance of the LDR changes from 100 Ω to 500 Ω as the light intensity decreases.



What is the voltmeter reading in the dark and in bright light respectively?

	In the dark	In bright light
A	15 V	15 V
B	15 V	25 V
C	20 V	5 V
D	25 V	10 V

37 Which of the following appliances is the most powerful and can be safely connected to the 240 V mains supply using a plug with a 5 A fuse?

A 850 W **B** 1 000 W **C** 1 250 W **D** 1 400 W

38 Which of the following situations does **not** cause a circuit breaker to trip?

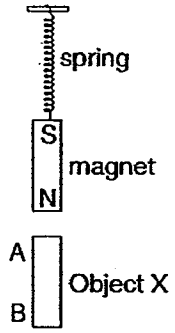
A A current of 10 A flowing through the live wire and 9.5 A in the neutral wire

B A current of 5 A flowing through the earth wire

C Lightning striking the live wire of a house

D A two-pin plug connected to a three-pin power supply

39 A magnet is suspended on a spring. An object *X* is brought near the magnet but the magnet does not move as shown in the diagram below.



What can object *X* be?

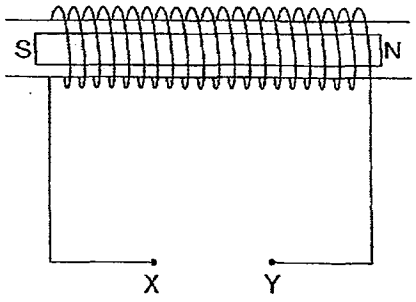
A a magnet with end *A* being north pole

B a magnet with end *A* being south pole

C an iron rod

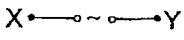
D a copper rod

40 The diagram below shows a steel bar placed inside a cardboard roll. Copper wire is wound around the cardboard roll.

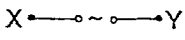


What should be connected across *X* and *Y* to magnetise the steel bar with the north and south poles as shown?

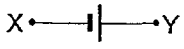
A 240 V



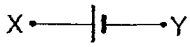
B 24 V



C 8 V



D 8 V



END OF PAPER

GESS Prelim 1 2014 Physics 5059/01

Question	Answer	Explanation
1	D	Ohm is V A^{-1}. W A^{-1} is volt.
2	A	$T = 0.2\text{ s} \times 8 = 1.6\text{ s}$ $f = \frac{1}{T}$ $= \frac{1}{1.6}$ $= \underline{0.63\text{ Hz}}$
3	D	The intersection point in a velocity-time graph does not indicate that both cars meet. Car *N* is leading throughout the 9 s. For 9 s, car *M* travels ½ × 9 × 8 = 36 m car *N* travels [½ × (4 + 6) × 7] + (2 × 6) = 47 m
4	B	Let *t* be the time taken by the spacecraft to strike the Moon after the engines are cut off and *v* be the velocity at which it strikes the Moon. $\frac{v-2}{t} = 1.6 \Rightarrow t = \frac{v-2}{1.6}$ $½ \times (2 + v) \times t = 4$ $½ \times (2 + v) \times \frac{v-2}{1.6} = 4$ $v^2 - 4 = 12.8$ $v = \underline{4.1\text{ m s}^{-1}}$
5	B	$\rightarrow F = ma$ $a = \frac{15}{3m} = \frac{5}{m}$ $\rightarrow T_1 = m\left(\frac{5}{m}\right) = \underline{5\text{ N}}$ $\rightarrow T_2 = 2m\left(\frac{5}{m}\right) = \underline{10\text{ N}}$
6	A	Friction acts between the ladder and the rough ground while there is no friction between the smooth wall and ladder. As the ladder tends to slide towards the left, friction acts towards the right.
7	C	A: Newton's **First** Law of Motion describes inertia. B: Objects with **more** mass have more inertia. D: **Friction** causes a moving object to decelerate.
8	A	side of cube = 5.3 mm = 0.53 cm $\rho = \frac{m}{V}$ $= \frac{0.40}{(0.53 \times 0.53 \times 0.53)}$ $= \underline{2.7\text{ g cm}^{-3}}$

Question	Answer	Explanation
9	B	$AB = \sqrt{5^2 - 3^2} = 4$ m Anticlockwise moment about O = 30 N × 4 m = 120 N m Clockwise moment about O = 20 N × 5 m = 100 N m Net moment = 120 N m − 100 N m = <u>20 N m anticlockwise</u>
10	D	When swing freely, an object will always come to rest with its centre of gravity vertically below the point of suspension.
11	D	weight of car = 12 000 N area of 4 tyres = 30 cm^2 = 0.003 0 m^2 $P = \frac{F}{A}$ $= \frac{12000}{0.0030}$ $= 4.00 \times 10^6$ Pa = <u>4.00 MPa</u>
12	A	The density of the liquid used will affect the height attained.
13	C	work done by the mother = force exerted by the mother × distance moved by the pram = 30 N × 5 m = <u>150 J</u>
14	C	By the principle of conservation of energy, E_k lost = thermal energy gained $½ \times 1\,600 \times v^2 = 500 \times 10^3$ v = <u>25 m s^{-1}</u>
15	B	The actual molecules are too small. It is impossible to see these actual molecules through a low power microscope.
16	A	The pressure the tyre experiences is due to the collisions the molecules make with the tyres.
17	D	I: constant-volume gas thermometer II: gas thermometer III: resistance thermometer
18	A	$\theta = \frac{l_\theta - l_0}{l_{100} - l_0} \times 100\,°C$ $= \frac{14-6}{22-6} \times 100\,°C$ = <u>50 °C</u>
19	C	The ignition temperature of the paper is higher than the boiling temperature of water. Heat is conducted to water quickly from the cup and any excess heat in water escapes as steam. Hence, the paper will not have enough heat to reach its ignition temperature.
20	A	Can 2 loses heat slowly as it is well insulated.

Question	Answer	Explanation
21	B	Evaporation brings about cooling.
22	C	$Pt = mc\Delta\theta$ $P \times (10 \times 60) = m \times 4\,200 \times (100 - 20)$ $P = 560m$ $Pt = ml_v$ $t = \frac{ml_v}{P}$ $= \frac{m(2.268 \times 10^6)}{560m}$ $= 4\,050$ s $= \underline{67.5 \text{ min}}$
23	D	Particles 1 and 3 are in phase while particles 1 and 2 are out of phase.
24	A	$3\lambda = 45$ mm $\lambda = \underline{15 \text{ mm}}$ $v = f\lambda$ $f = \frac{v}{\lambda}$ $= \frac{60}{15}$ $= \underline{4 \text{ Hz}}$
25	C	The image must be laterally inverted.
26	B	The focal length of the lens is the distance between the optical centre and the principal focus.
27	D	Radio waves has the longest wavelength, followed by microwaves.
28	A	The speed of all electromagnetic waves in air is approximately 3×10^8 m s^{-1} while the speed of sound wave is approximately 340 m s^{-1}.
29	B	Distance between a rarefaction and an adjacent compression $= \frac{\lambda}{2}$ $= \frac{(340 \div 1000)}{2}$ $= \underline{0.17 \text{ m}}$
30	B	There are four regions of compressions which have slightly higher pressure than the surrounding air pressure. Hence, there should be four crests starting with a trough (that is, the centre of rarefaction).
31	C	The left plate is connected to the positive terminal of the battery while the right plate is connected to the negative terminal of the battery. As the sphere is positively charged, it will repel from the positively-charged plate (on the left) and attract to the negatively-charged plate (on the right).

Question	Answer	Explanation
32	C	Electrons in conductor *A* move to the right side of the conductor as they are repelled by the negatively-charged rod. Earthing takes place on the right side of conductor *A* where electrons move from *A* to the hand. After the hand, followed by the negatively-charged rod are removed, conductor *A* becomes positively-charged. Hence, the electrons in conductor *B* move to *P*.
33	D	V_1 measures the e.m.f. of the two cells in parallel. The effective e.m.f. produced by the two cells in parallel is equivalent to that of one cell. Therefore, $V_1 = \underline{1.5\ V}$. V_2 measures the total e.m.f. produced in the circuit. $V_2 = \underline{3.0\ V}$. V_2 is also the potential difference across the bulb. energy = QV $= 48\ C \times 3.0\ V$ $= \underline{144\ J}$
34	B	$\frac{1}{R_T} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6}$ $= ½$ $R_T = \underline{2\ \Omega}$
35	C	Light bulb *Q* is short-circuited as the diode is forward biased when the switch is on.
36	B	In the dark, $V = \frac{500}{(500+500)} \times 30 = \underline{15\ V}$ In bright light, $V = \frac{500}{(100+500)} \times 30 = \underline{25\ V}$
37	B	$I = \frac{P}{V}$ $= \frac{1000}{240}$ $= 4.2\ A < 5\ A$ The fuse must have a slightly higher rating than the actual current flowing in an appliance.
38	D	A: Currents in the live and neutral wire are not equal. The circuit breaker trips. B: Current in the earth wire indicates a current leakage. C: Lightning carries excessive current which will cause the circuit breaker to trip. D: A two-pin plug can be connected to a three-pin power supply without any potential hazard.
39	D	Copper is a non-magnetic material which has no impact on the magnet. Hence the magnet does not move.
40	D	A direct current flowing from *X* to *Y* is required for the right side of the steel bar to become north pole.

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GAN ENG SENG SCHOOL

Preliminary 1 Examination 2014

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

PHYSICS

Paper 2

5059/02

14 May 2014
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name 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/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 10** 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.
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

Section A [50 marks]

For Examiner's Use

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

1 Coven wanted to find out if a piece of optical fibre (cylindrical in shape) was able to float on glycerine of density 1 260 kg/m^3. He was given a micrometer screw gauge with a zero error of -0.03 mm, an electronic balance, a metre rule to determine the density of the optical fibre and then deduced if it could float on glycerine.

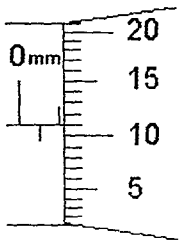


Fig. 1

Fig. 1 showed the observed reading of the diameter of the optical fibre.

(a) What was the actual diameter of the optical fibre?

..... [1]

(b) The length of the optical fibre as measured by the metre rule was 30.0 cm. When it was placed on the electronic balance, the balance read 0.36 g. Show your workings clearly to support his deduction. [3]

.....

.....

.....

For Examiner's Use

2 A kite of mass 5.0 kg is flying at a constant velocity of 2.5 m/s in the sky. The force of wind can be seen as a single force of 80 N acting at an angle of 20 ° to the horizontal.

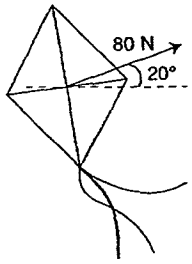


Fig. 2

(a) Explain why the resultant force on the kite must be zero.

.....

.....

.....

..... [2]

(b) By means of a scale diagram, find the magnitude and direction of the air resistance acting on the kite. [3]

.....

.....

.....

For Examiner's Use

3 (a) A motor of radius 1.2 m spins and pulls a rope connected to a mass of 10 kg. The motor spins and raises the mass to a height of 3.0 m in 20 s at constant speed.

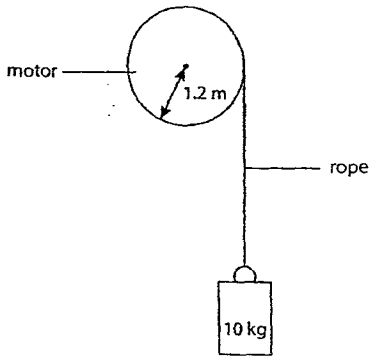


Fig. 3.1

(i) Calculate the tension in the rope. [1]

(ii) Calculate the moment generated by the motor. [2]

(iii) Calculate the power supplied by the motor. [2]

For Examiner's Use

3 (b) A stuntman is driving a car such that it moves only with two tyres in contact with the ground as shown in Fig. 3.2.

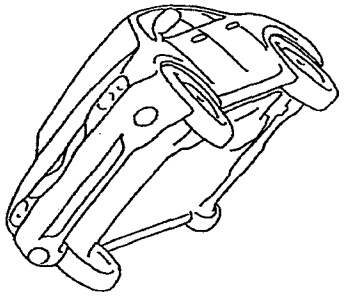


Fig. 3.2

(i) State the position of the centre of gravity of the car.

.....

.....

..... [1]

(ii) Explain why it is more difficult to perform this stunt using a bus.

.....

.....

.....

..... [1]

For Examiner's Use

4 (a) Fig. 4 shows a basic hydraulic system. A load of mass 50 kg is placed on piston *M*. The cross-sectional area of piston *M* is 2.5 m^2 and piston *N* is 12.5 m^2.

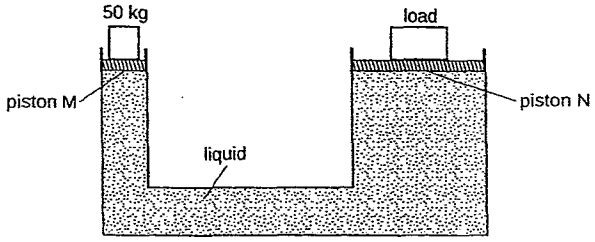


Fig. 4

(i) Calculate the maximum mass of load that can be lifted by piston *N*. [2]

(ii) Explain why the hydraulic system becomes inefficient if air bubbles are present in the liquid.

.....

.....

..... [1]

For Examiner's Use

4 (b) To propel a water rocket, air is compressed in a bottle which has been partially filled with water. Initially, the bottle that was filled with water had air of 10 cm^3 at atmospheric pressure. An additional 50 cm^3 of air at atmospheric pressure was then pumped into the bottle. Calculate the final pressure of the compressed air in the bottle. (Atmospheric pressure = 100 kPa; temperature is assumed to be constant.) [2]

(c) A balloon, which had been inflated at room temperature, is placed into a bucket of ice for some time. Using the kinetic model of matter, describe and explain what will happen to the balloon when it is placed in the ice.

.....

.....

.....

.....

.....

..... [2]

For Examiner's Use

5 (a) Fig. 5 shows an object *XY* placed beyond 2*F* of a converging lens of a fixed focal length *F*. A plane mirror is added to the set up.

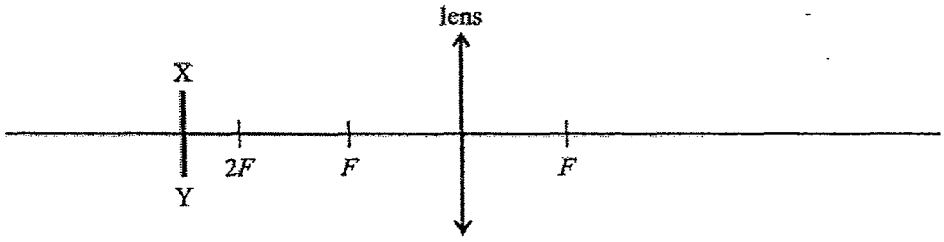


Fig. 5

Complete the diagram to locate the image. Label the image *X'Y'*. [3]

(b) A beam of ultrasonic waves of frequency 25 kHz travels from water to air at an angle of incidence of 60 °. Given that the speeds of sound in seawater and in air are 1 500 m/s and 340 m/s respectively, calculate

(i) the wavelength of the ultrasonic waves in seawater, [2]

(ii) the angle of refraction. Hence draw a well-labelled diagram to show the incident and refracted beams. [3]

For Examiner's Use

6 (a) Fig. 6.1 shows an experiment to find the electric field pattern between two electrodes. When garlic powder is distributed evenly on the dish filled with oil, an electric field pattern is observed.

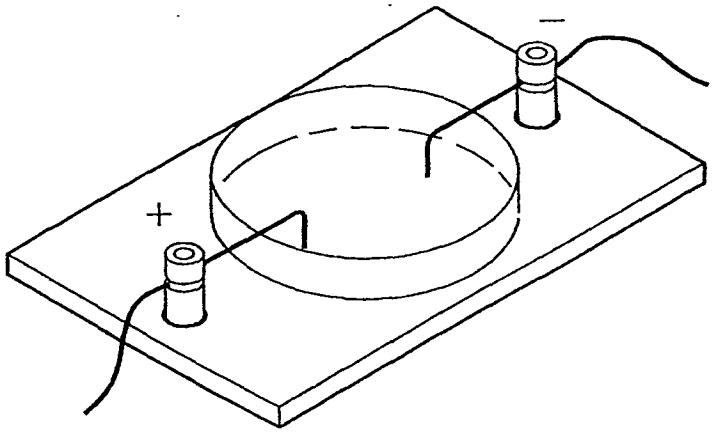


Fig. 6.1

(i) Describe how the electric field pattern is shown.

.....

..... [1]

(ii) Draw the electric field pattern on the dish in Fig. 6.1. [1]

(iii) If the terminals of the electrodes are reversed, will the electric field pattern be changed?

..... [1]

For Examiner's Use

6 **(b)** An electric kettle rated '240 V, 1 500 W' is used to heat 1 kg of water from 20 °C to 100 °C in 5 minutes. Given that the specific heat capacity of water is 4 200 J kg^{-1} $°C^{-1}$, calculate

(i) the electrical energy consumed by the kettle, [2]

(ii) the thermal energy absorbed by the water, and [2]

(iii) the efficiency of the kettle. [2]

For Examiner's Use

6 (c) Fig. 6.2 shows a circuit containing four identical resistors, R_1 to R_4 and two switches S_1 and S_2. The rating for each resistor is '24 W, 12 V'.

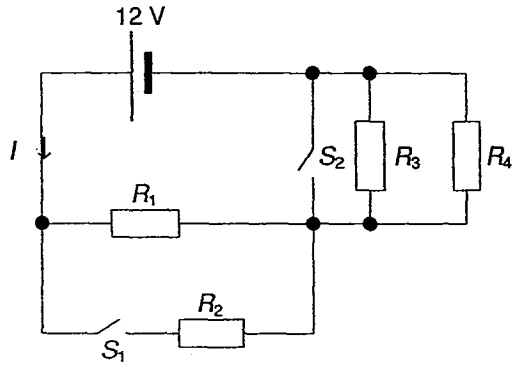


Fig. 6.2

(i) Calculate the resistance for each light bulb. [1]

(ii) When both switches are closed, calculate I, the current leaving the cell. [3]

For Examiner's Use

7 Fig. 7 shows the structure of an electric door bell.

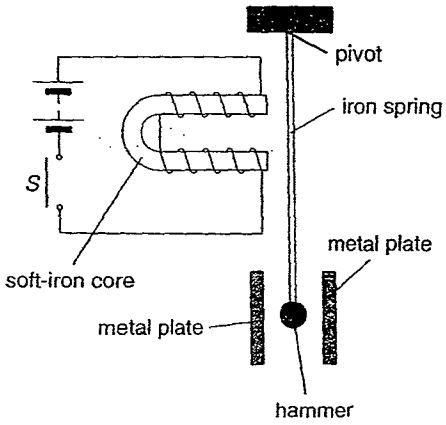


Fig. 7

(a) Describe, with reasons, the motion of the iron spring when the switch *S* is pressed and then released.

.....

.....

.....

.....

..... [2]

(b) State and explain what happens to

(i) the sound produced by the bell if the soft-iron core is wound by more turns of coil, and

.....

.....

.....

..... [2]

(ii) the loudness of the sound produced by the bell if the soft-iron core is replaced by a copper core.

.....

.....

.....

..... [2]

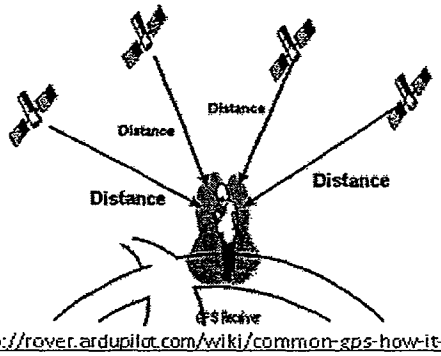
Section B [30 marks]

For Examiner's Use

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 10.**

8 Read the article about the Global Positioning System (GPS) and answer the questions that follow. (Reference: http://www8.garmin.com/aboutGPS/ – with simplifications)

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of satellites placed into orbit by the U.S. Department of Defence. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day.



http://rover.ardupilot.com/wiki/common-gps-how-it-works/

GPS satellites circle the earth in a very precise orbit and transmit signal information to earth. GPS receivers take this information to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the receiver's electronic map.

Civilian GPS satellites transmit a low power radio signal at a frequency of 1.57542 GHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains.

The satellites that make up the GPS space segment are constantly moving and they orbit the earth about 19 300 km above us. These satellites are travelling at speeds of roughly 11 250 km/h. Each GPS satellite, powered by solar energy, has backup batteries (charged by sunlight) and it is designed to last for about 10 years on average. It also carries small rocket boosters on board to keep it flying in the correct circular / elliptical path.

(a) State the speed of the signal travelling between a GPS receiver and a GPS satellite.

..... [1]

(b) Based on data given in the passage,

(i) how long does it take for a GPS receiver to receive a signal form a GPS satellite?

.....

..... [2]

For Examiner's Use

8 (b) (ii) what is the wavelength of a typical signal from a GPS satellite?

.....

..... [2]

(c) State the energy conversion that occurs in a GPS satellite when it is orbiting the Earth.

.....

..... [2]

(d) A GPS satellite emits radio waves that do not penetrate buildings. This means that people inside buildings or at underground basements cannot use GPS. In order to overcome this problem, it was proposed that GPS satellites emit more powerful electromagnetic radiation such as X-rays. Suggest a reason why such a suggestion is undesirable.

.....

..... [1]

(e) Suggest a reason why backup batteries are carried on each GPS satellite.

.....

..... [1]

(f) Assuming the small rocket boosters in each GPS satellite are not switched on, state how the net force is acting on the satellite.

.....

..... [1]

For Examiner's Use

9 Tammy bought a water boiler rated '240 V, 1 000 W'. She went to Japan for a tour and connected the plug of the boiler to the socket. When she switched on the boiler, the power was found to be 250 W. Assume that the resistance of the boiler remains constant.

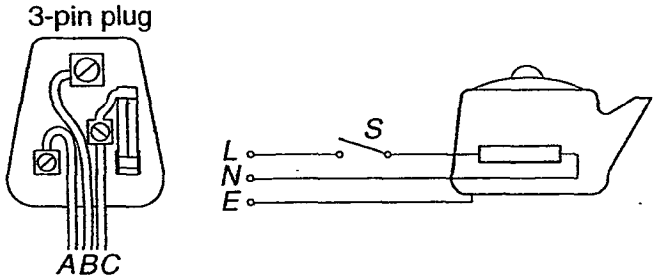


Fig. 9

(a) Calculate the voltage supplied across the socket. [2]

(b) Give one advantage and one disadvantage of changing the household voltage supply to a higher value.

.....

.....

.....

..... [2]

(c) Fig. 9 shows the boiler and its 3-pin plug. The live wire *L*, the neutral wire *N* and the earth wire *E* are to be connected to the wires in the plug. Use and state the colours of the coating of the three wires *A*, *B* and *C* to complete the wiring in Fig. 9. [3]

Wire *A* .....

Wire *B* .....

Wire *C* .....

For Examiner's Use

9 **(d)** Explain why the earth pin is longer than the other pins in a 3-pin plug.

.....

.....

.....

..... [2]

(e) The boiler is switched on in Singapore for 30 days with 5 hours of usage daily. What is the cost of using the boiler if the cost of electricity is $0.25 per kW h?

.....

..... [1]

For Examiner's Use

10 EITHER

A ball rolls down a frictionless inclined plane placed near the edge of the table and falls freely onto the floor after reaching the end of the slope. The velocity-time graph of the ball as it rolls down the slope until it touches the floor is shown in Fig. 10.2. The point *C* shows the velocity of the ball just before it touches the floor. The acceleration due to gravity can be assumed to be 10 m/s^2. You may assume that there is negligible air resistance.

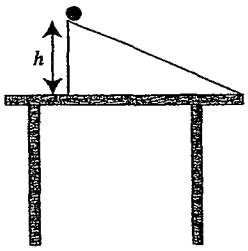


Fig. 10.1

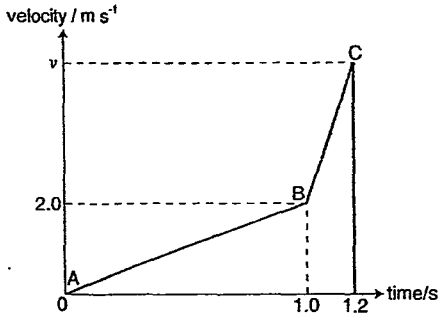


Fig. 10.2

(a) Deduce the velocity of the ball when it reaches the end of the slope.

..... [1]

(b) Calculate the length of the slope. [1]

(c) Calculate the acceleration as the ball moves from *A* to *B*. [2]

For Examiner's Use

10 (d) (i) State the principle of conservation of energy.

.....

.....

.....

..... [1]

(ii) Calculate the height of the slope from the table top, *h*. [3]

(e) Calculate the height of the table from the floor. [2]

For Examiner's Use

10 OR

The human body has several mechanisms to regulate body temperature so that body temperature is maintained at about 37 °C. On a hot day, sweat glands under the skin secrete sweat and the evaporation of the sweat helps the body to lose heat. When the weather turns cold, hair on the skin stand on its end and hence traps air. In addition, the blood vessels near the skin constrict, resulting in less blood flow.

(a) Name the type of electromagnetic wave that makes us feel warm.

..... [1]

(b) Explain how the trapping of air near the skin surface helps to keep the body warm.

.....

.....

.....

..... [2]

(c) Explain how the body may lose heat by convection.

.....

.....

.....

.....

.....

..... [2]

For Examiner's Use

10 (d) Alvin has a mass of 80 kg. The specific heat capacity of his body is about 3 500 J kg^{-1} K^{-1}.

(i) Explain what it means by *the specific heat capacity of Alvin's body is 3 500 J kg^{-1} K^{-1}.*

.....

.....

..... [1]

(ii) Explain the difference between evaporation and boiling.

.....

.....

..... [1]

(iii) What is the mass of sweat Alvin needs to lose in order for his body temperature to drop by 0.5 °C? Assume that the specific latent heat of vaporisation of sweat is 2 200 kJ kg^{-1}. [3]

END OF PAPER

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GAN ENG SENG SCHOOL
Preliminary 1 Examination 2014

CANDIDATE NAME	
CLASS	
INDEX NUMBER	

Marking Scheme

PHYSICS
Paper 2

5059/02

14 May 2014
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name 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/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 10** 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.
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

Section A [50 marks]

For Examiner's Use

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

1 Coven wanted to find out if a piece of optical fibre (cylindrical in shape) was able to float on glycerine of density 1 260 kg/m^3. He was given a micrometer screw gauge with a zero error of -0.03 mm, an electronic balance, a metre rule to determine the density of the optical fibre and then deduced if it could float on glycerine.

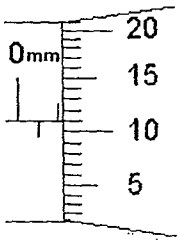


Fig. 1

Fig. 1 showed the observed reading of the diameter of the optical fibre.

(a) What was the actual diameter of the optical fibre?

1.11 mm – (-0.03 mm) = **1.14 mm** [B1]

(b) The length of the optical fibre as measured by the metre rule was 30.0 cm. When it was placed on the electronic balance, the balance read 0.36 g. Show your workings clearly to support his deduction. [3]

Volume of optical fibre, $V = \pi r^2 h$

$$= 3.142 \times \left(\frac{0.114}{2}\right)^2 \times 30.0$$

$$= 0.30625 \text{ cm}^3$$

Density of optical fibre, $\rho = \frac{m}{V}$

$$= \frac{0.36}{0.30625}$$

$$= 1.18 \text{ g/cm}^3 \quad [B1]$$

The optical fibre will **float on** [B1] the glycerine because **it is less dense than glycerine**. [B1]

Give [B1] only if no clear working is shown even though deduction and explanation are correct.

Give [B2] if there is calculation error in unit conversion but deduction and explanation are correct.

For Examiner's Use

2 A kite of mass 5.0 kg is flying at a constant velocity of 2.5 m/s in the sky. The force of wind can be seen as a single force of 80 N acting at an angle of 20 ° to the horizontal.

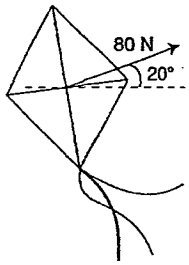


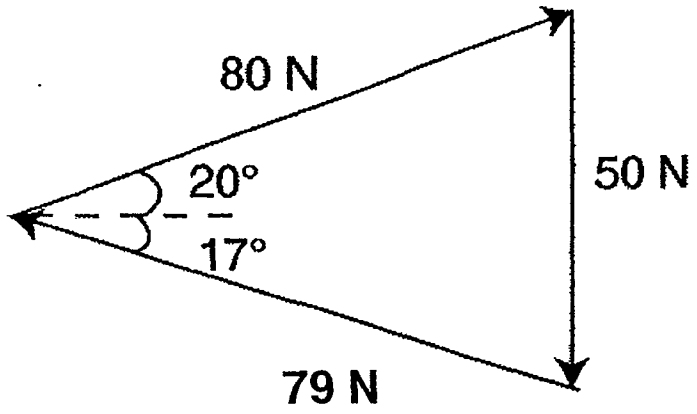
Fig. 2

(a) Explain why the resultant force on the kite must be zero.

As the kite is flying at a constant velocity, there is zero acceleration. [B1]
Since resultant force is equal to the product of mass and acceleration, therefore it must be zero. [B1]

(b) By means of a scale diagram, find the magnitude and direction of the air resistance acting on the kite. [3]

Scale
1 cm : 10 N



The magnitude of the air resistance is **79 N ± 1 N** [B1] and it makes angle of **37 ° ± 1 °** with **80 N**. [B1]

Deduce [B1] either if there is no scale given for the diagram or the direction of arrow for air resistance is incorrect

For Examiner's Use

3 (a) A motor of radius 1.2 m spins and pulls a rope connected to a mass of 10 kg. The motor spins and raises the mass to a height of 3.0 m in 20 s at constant speed.

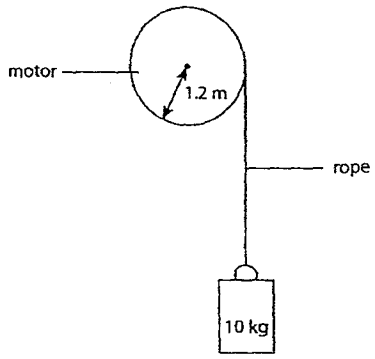


Fig. 3.1

(i) Calculate the tension in the rope. [1]

$\uparrow T = W$
$= mg$
$= 10\ \text{kg} \times 10\ \text{N/kg}$
$= \underline{\mathbf{100\ N}}$

(ii) Calculate the moment generated by the motor. [2]

Anticlockwise moment generated by the motor
$= 100\ \text{N} \times 1.2\ \text{m}$ [M1]
$= \underline{\mathbf{120\ N\ m}}$ [A1]

(iii) Calculate the power supplied by the motor. [2]

$P = \frac{E}{t}$
$= \frac{mgh}{t}$
$= \frac{10 \times 10 \times 3.0}{20}$ [M1]
$= \underline{\mathbf{15\ W}}$ [A1]

For Examiner's Use

3 (b) A stuntman is driving a car such that it moves only with two tyres in contact with the ground as shown in Fig. 3.2.

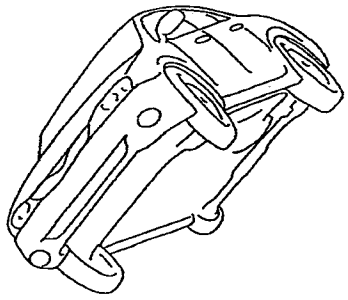


Fig. 3.2

(i) State the position of the centre of gravity of the car.

The centre of gravity of the tilted car is directly above the area where the tyres are in contact with the ground. [B1]

(ii) Explain why it is more difficult to perform this stunt using a bus.

Since a bus is taller than a car, its centre of gravity is higher. Therefore, a bus is less stable than a car and it is more difficult to perform this stunt. [B1]

For Examiner's Use

4 **(a)** Fig. 4 shows a basic hydraulic system. A load of mass 50 kg is placed on piston *M*. The cross-sectional area of piston *M* is 2.5 m^2 and piston *N* is 12.5 m^2.

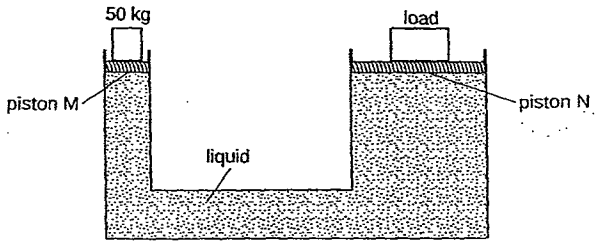


Fig. 4

(i) Calculate the maximum mass of load that can be lifted by piston *N*. [2]

pressure exerted by piston *M* = pressure exerted by piston *N*

$$\frac{F_M}{A_M} = \frac{F_N}{A_N}$$

$$\frac{50 \times 10}{2.5} = \frac{F_N}{12.5} \quad \text{[B1]}$$

$$F_N = 2\,500 \text{ N}$$

maximum mass of load that can be lifted by piston $N = \frac{2500}{10}$

$= \underline{\textbf{250 kg}}$ [B1]

(ii) Explain why the hydraulic system becomes inefficient if air bubbles are present in the liquid.

Air bubbles can be compressed easily. Hence, pressure will not be transmitted from piston *M* to piston *N* effectively. [B1]

For Examiner's Use

4 **(b)** To propel a water rocket, air is compressed in a bottle which has been partially filled with water. Initially, the bottle that was filled with water had air of 10 cm^3 at atmospheric pressure. An additional 50 cm^3 of air at atmospheric pressure was then pumped into the bottle. Calculate the final pressure of the compressed air in the bottle. (Atmospheric pressure = 100 kPa; temperature is assumed to be constant.) [2]

$P_1V_1 = P_2V_2$
$(100 \times 10^3) \times (10 + 50) = P_2 \times 10$ [M1]
$P_2 =$ **600 000 Pa** [A1]

(c) A balloon, which had been inflated at room temperature, is placed into a bucket of ice for some time. Using the kinetic model of matter, describe and explain what will happen to the balloon when it is placed in the ice.

When the air in the balloon is cooled, the air molecules have less kinetic energy and exert a lower pressure on the walls of the balloon. [B1] **As the pressure in the internal walls is less than the outside air pressure, the volume of the balloon decreases.** [B1]

For Examiner's Use

5 (a) Fig. 5 shows an object *XY* placed beyond 2*F* of a converging lens of a fixed focal length *F*. A plane mirror is added to the set up.

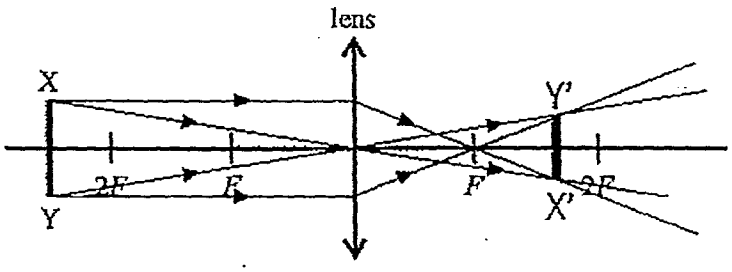


Fig. 5

Complete the diagram to locate the image. Label the image *X'Y'*. [3]

[B1] for drawing the two correct rays (with arrows) from *X*
[B1] for drawing the two correct rays (with arrows) from *Y*
[B1] for drawing and labelling the image correctly

(b) A beam of ultrasonic waves of frequency 25 kHz travels from water to air at an angle of incidence of 60 °. Given that the speeds of sound in seawater and in air are 1 500 m/s and 340 m/s respectively, calculate

(i) the wavelength of the ultrasonic waves in seawater, [2]

$$v = f\lambda \Rightarrow \lambda = \frac{v}{f}$$

$$= \frac{1500}{(25\times10^3)} \qquad [M1]$$

$$= \underline{\mathbf{0.06\ m}} \qquad [A1]$$

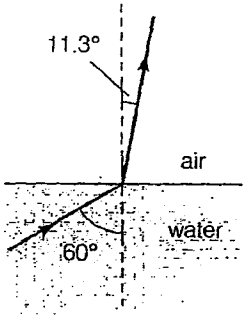
(ii) the angle of refraction. Hence draw a well-labelled diagram to show the incident and refracted beams. [3]

$$\frac{\sin 60°}{\sin r} = \frac{1500}{340} \qquad [B1]$$

$r = \underline{\mathbf{11.3\ °}}$ [B1]

[B1] for drawing diagram correctly

[B1] for drawing refracted ray bending towards the normal if the calculation is incorrect



For Examiner's Use

6 (a) Fig. 6 shows an experiment to find the electric field pattern between two electrodes. When garlic powder is distributed evenly on the dish filled with oil, an electric field pattern is observed.

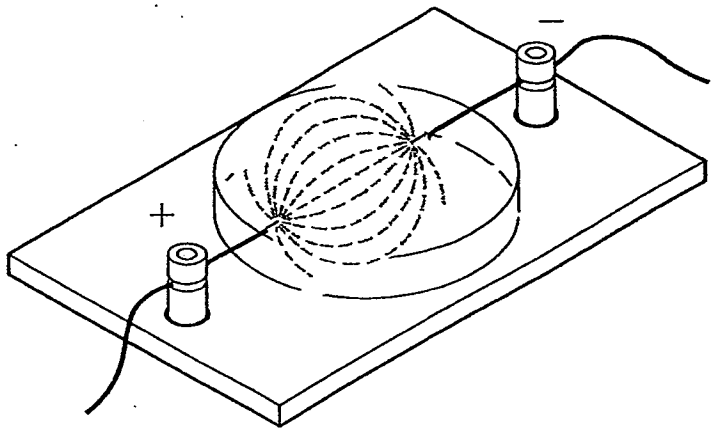


Fig. 6

(i) Describe how the electric field pattern is shown.

Electric field pattern is represented by the pattern of the alignment of garlic powder. [B1]

(ii) Draw the electric field pattern on the dish in Fig. 6. [B1]

(iii) If the terminals of the electrodes are reversed, will the electric field pattern be changed?

No [B1]

For Examiner's Use

6 **(b)** An electric kettle rated '240 V, 1 500 W' is used to heat 1 kg of water from 20 °C to 100 °C in 5 minutes. Given that the specific heat capacity of water is 4 200 J kg^{-1} $°C^{-1}$, calculate

(i) the electrical energy consumed by the kettle, [2]

$E = Pt$
$= 1\,500 \times (5 \times 60)$ [M1]
$= \underline{\mathbf{450\,000\ J}}$ [A1]

(ii) the thermal energy absorbed by the water, and [2]

$Q = mc\Delta\theta$
$= 1 \times 4\,200 \times (100 - 20)$ [M1]
$= \underline{\mathbf{336\,000\ J}}$ [A1]

(iii) the efficiency of the kettle. [2]

$$\text{efficiency of the kettle} = \frac{\text{useful energy}}{\text{input energy}} \times 100\,\%$$

$$= \frac{336000}{450000} \times 100\,\% \quad \text{[M1]}$$

$= \underline{\mathbf{74.7\,\%}}$ [A1]

For Examiner's Use

6 (c) Fig. 6.2 shows a circuit containing four identical resistors, R_1 to R_4 and two switches S_1 and S_2. The rating for each resistor is '24 W, 12 V'.

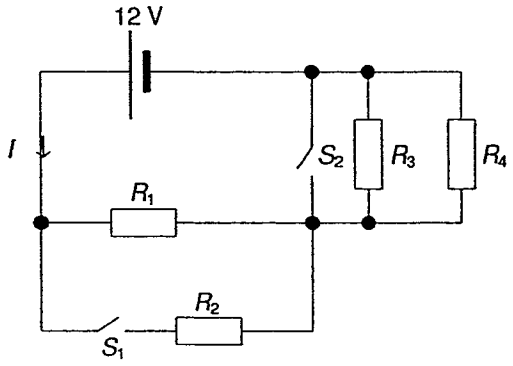


Fig. 6.2

(i) Calculate the resistance for each resistor. [1]

$$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$$
$$= \frac{12^2}{24}$$
$$= \underline{\mathbf{6\ \Omega}} \qquad \text{[B1]}$$

(ii) When both switches are closed, calculate I, the current leaving the cell. [3]

When both switches are closed, short circuit occurs and no current flows through R_3 and R_4.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$= \frac{1}{6} + \frac{1}{6}$$
$$= \frac{1}{3}$$
$$R = 3\ \Omega \qquad \text{[B1]}$$
$$V = IR \Rightarrow I = \frac{V}{R} \qquad \text{[M1]}$$
$$= \frac{12}{3}$$
$$= \underline{\mathbf{4\ A}} \qquad \text{[A1]}$$

For Examiner's Use

7 Fig. 7 shows the structure of an electric door bell.

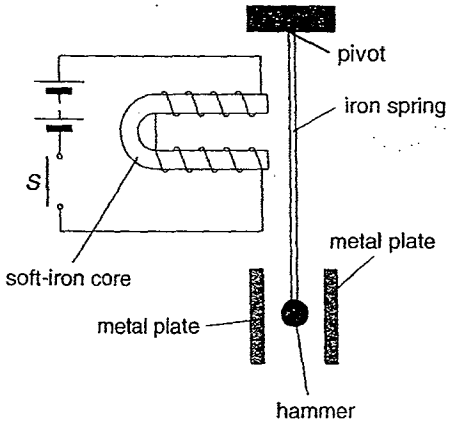


Fig. 7

(a) Describe, with reasons, the motion of the iron spring when the switch *S* is pressed and then released.

When *S* is closed, current passes through the coil. The soft-iron core is magnetised and the iron spring is attracted to the core and hits the left metal plate to produce a sound. [B1] **When *S* is released, the iron spring returns and hits the right metal plate,** [B1] **producing another sound.**

(b) State and explain what happens to

(i) the sound produced by the bell if the soft-iron core is wound by more turns of coil, and

A louder sound of the same pitch is produced [B1] **as the electromagnet becomes stronger and the iron spring hits the metal plate more violently.** [B1]

(ii) the loudness of the sound produced by the bell if the soft-iron core is replaced by a copper core.

The loudness of the sound produced decreases [B1] **as the electromagnet becomes weaker for copper cannot be magnetised.** [B1]

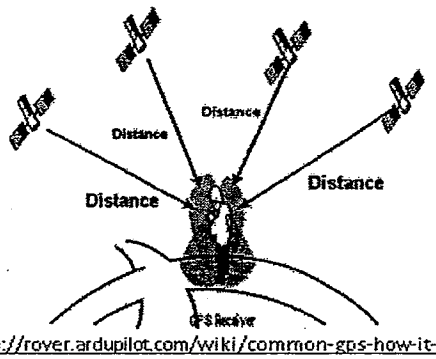
Section B [30 marks]

For Examiner's Use

Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 10.**

8 Read the article about the Global Positioning System (GPS) and answer the questions that follow. (Reference: http://www8.garmin.com/aboutGPS/ – with simplifications)

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of satellites placed into orbit by the U.S. Department of Defence. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day.



http://rover.ardupilot.com/wiki/common-gps-how-it-works/

GPS satellites circle the earth in a very precise orbit and transmit signal information to earth. GPS receivers take this information to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the receiver's electronic map.

Civilian GPS satellites transmit a low power radio signal at a frequency of 1.57542 GHz in the UHF band. The signals travel by line of sight, meaning they will pass through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains.

The satellites that make up the GPS space segment are constantly moving and they orbit the earth about 19 300 km above us. These satellites are travelling at speeds of roughly 11 250 km/h. Each GPS satellite, powered by solar energy, has backup batteries (charged by sunlight) and it is designed to last for about 10 years on average. It also carries small rocket boosters on board to keep it flying in the correct circular / elliptical path.

(a) State the speed of the signal travelling between a GPS receiver and a GPS satellite.

3.0×10^8 m/s [B1]

(b) Based on data given in the passage,

(i) how long does it take for a GPS receiver to receive a signal form a GPS satellite?

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$= (19\,300 \times 10^3) \div (3.0 \times 10^8)$ [M1]
$= \mathbf{0.0643\ s}$ [A1]

For Examiner's Use

8 (b) (ii) what is the wavelength of a typical signal from a GPS satellite?

$$v = f\lambda \Rightarrow \lambda = \frac{v}{f}$$

$$= \frac{3\times10^{8}}{1.57542\times10^{9}} \quad [M1]$$

$$= \underline{\mathbf{0.190\ m}} \quad [A1]$$

(c) State the energy conversion that occurs in a GPS satellite when it is orbiting the Earth.

Solar energy converted to **electrical energy** [B1] and **chemical potential energy** (stored in backup batteries charged by sunlight). [B1]

(d) A GPS satellite emits radio waves that do not penetrate buildings. This means that people inside buildings or at underground basements cannot use GPS. In order to overcome this problem, it was proposed that GPS satellites emit more powerful electromagnetic radiation such as X-rays. Suggest a reason why such a suggestion is undesirable.

Any **one** of the following answers [B1]

- May cause premature aging and shortening of lifespan
- May cause damage to proteins / nucleic acids / chromosomes in human cells / ionisation of cells
- May cause deformity to unborn foetus
- May cause abnormal cell division, leading to cancer (e.g., leukaemia)
- May cause genetic mutation

(e) Suggest a reason why backup batteries are carried on each GPS satellite.

They are used to power the GPS satellite when satellite is hidden from sunlight. [B1]

(f) Assuming the small rocket boosters in each GPS satellite are not switched on, state how the net force is acting on the satellite.

Gravitational force of attraction between Earth and the satellite / weight of the satellite [B1]

For Examiner's Use

9 Tammy bought a water boiler rated '240 V, 1 000 W'. She went to Japan for a tour and connected the plug of the boiler to the socket. When she switched on the boiler, the power was found to be 250 W. Assume that the resistance of the boiler remains constant.

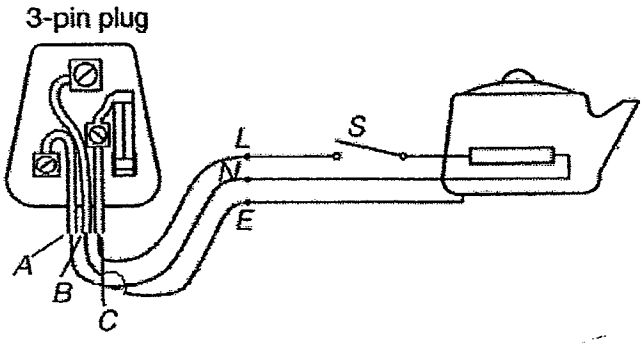


Fig. 9

(a) Calculate the voltage supplied across the socket. [2]

$$\frac{1000}{250} = \left(\frac{240}{V}\right)^2$$ [M1]

$V =$ **120 V** [A1]

(b) Give one advantage and one disadvantage of changing the household voltage supply to a higher value.

The advantage is that the electrical appliances have greater power. [B1] **The disadvantage is that thicker wires (more costly) are required.** [B1]

(c) Fig. 9 shows the boiler and its 3-pin plug. The live wire *L*, the neutral wire *N* and the earth wire *E* are to be connected to the wires in the plug. Use and state the colours of the coating of the three wires *A*, *B* and *C* to complete the wiring in Fig. 9. [3]

Wire *A* **blue**

Wire *B* **yellow and green**

Wire *C* **brown**.

[B1] for every two correct answers

For Examiner's Use

9 **(d)** Explain why the earth pin is longer than the other pins in a 3-pin plug.

The earth pin is longer so that nobody can put his fingers into the live and neutral holes of the socket, [B1] **for the *L* and *N* holes are opened only when the earth hole is opened by the insertion of the earth pin.** [B1]

(e) The boiler is switched on in Singapore for 30 days with 5 hours of usage daily. What is the cost of using the boiler if the cost of electricity is $0.25 per kW h?

Cost = [(1 kW × 5 h) × 30] × $0.25
= **$37.50** [B1]

For Examiner's Use

10 EITHER

A ball rolls down a frictionless inclined plane placed near the edge of the table and falls freely onto the floor after reaching the end of the slope. The velocity-time graph of the ball as it rolls down the slope until it touches the floor is shown in Fig. 10.2. The point *C* shows the velocity of the ball just before it touches the floor. The acceleration due to gravity can be assumed to be 10 m/s^2. You may assume that there is negligible air resistance.

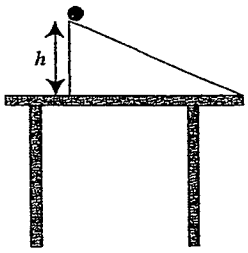


Fig. 10.1

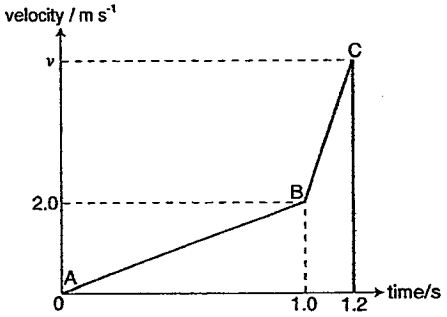


Fig. 10.2

(a) Deduce the velocity of the ball when it reaches the end of the slope. [1]

2.0 m/s [B1]

(b) Calculate the length of the slope. [1]

length of slope = area under velocity-time graph from *A* to *B*
= ½ × 1.0 × 2.0
= **1.0 m** [B1]

(c) Calculate the acceleration as the ball moves from *A* to *B*. [2]

$$a = \frac{v-u}{t}$$
$$= \frac{2.0-0}{1.0} \quad [M1]$$
$$= \mathbf{2.0\ m/s^2} \quad [A1]$$

For Examiner's Use

10 (d) (i) State the principle of conservation of energy.

The principle of conservation of energy states that energy cannot be created or destroyed but can be converted from one form to another, with the total energy remaining the same. [B1]

(ii) Calculate the height of the slope from the table top, h. [3]

By the principle of conservation of energy,
E_p lost = E_k gained
$mgh = \frac{1}{2}mv^2$ [B1]
$10 \times h = \frac{1}{2} \times (2.0)^2$ [M1]
$h =$ **0.2 m** [A1]

(e) Calculate the height of the table from the floor. [2]

velocity at $C = 2.0 + [10 \times (1.2 - 1.0)]$
$= 4.0$ m/s [B1]
height of table from the floor = area under velocity-time graph from B to C
$= \frac{1}{2} \times (2.0 + 4.0) \times (1.2 - 1.0)$
= **0.60 m** [B1]

For Examiner's Use

10 **OR**

The human body has several mechanisms to regulate body temperature so that body temperature is maintained at about 37 °C. On a hot day, sweat glands under the skin secrete sweat and the evaporation of the sweat helps the body to lose heat. When the weather turns cold, hair on the skin stand on its end and hence traps air. In addition, the blood vessels near the skin constrict, resulting in less blood flow.

(a) Name the type of electromagnetic wave that makes us feel warm.

Infra-red radiation [B1]

(b) Explain how the trapping of air near the skin surface helps to keep the body warm.

Air is a good insulator of heat [B1] **and thus reduces heat loss from the body to the surroundings by conduction.** [B1]

(c) Explain how the body may lose heat by convection.

Heat is transferred from our body to the air by conduction. As the air near our skin becomes heated, it expands and becomes less dense than the surrounding air and thus rises. [B1] **This causes the cold air to sink, which is in turn heated by our body. The continuous flow of convection air current causes our body to lose heat quickly.** [B1]

For Examiner's Use

10 (d) Alvin has a mass of 80 kg. The specific heat capacity of his body is about 3 500 J kg^{-1} K^{-1}.

(i) Explain what it means by *the specific heat capacity of Alvin's body is 3 500 J kg^{-1} K^{-1}.*

It means that Alvin needs to absorb 3 500 J of energy per unit mass to raise his temperature by 1 °C or 1 K. [B1]

(ii) Explain the difference between evaporation and boiling.

Boiling must occur at boiling point of a liquid but evaporation can occur at any temperature. [B1; other differences as shown in textbook is also acceptable.]

(iii) What is the mass of sweat Alvin needs to lose in order for his body temperature to drop by 0.5 °C? Assume that the specific latent heat of vaporisation of sweat is 2 200 kJ kg^{-1}. [3]

By the principle of conservation of energy,
energy lost by body = energy gained by sweat

$m_{body} c \Delta\theta = m_{sweat} l_v$ [B1]

$80 \times 3\,500 \times 0.5 = m_{sweat} \times (2\,200 \times 10^3)$ [M1]

$m_{sweat} =$ **0.0636 kg** [A1]

END OF PAPER