O

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME

CLASS

INDEX NUMBER

SCIENCE (PHYSICS, CHEMISTRY)

5076/01
15 September 2015
1 hour

FOUR NORMAL ACADEMIC(O) / FOUR EXPRESS/ FIVE NORMAL ACADEMIC

Paper 1 Multiple Choice
Additional Matenals 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 cover page and shade in your index number on 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.
A copy of periodic table is printed on page __ XX__.

Total Marks
40

This paper consists of XX printed pages including the cover page

1 Which of the following instrument(s) is/are used for measuring density of a liquid?

i electronic balance
ii metre rule
iii hydrometer
iv barometer

A i and ii
B ii and iv
C iii and iv
D iii only

2 A mass, m is being pushed by a force, F, on a frictionless surface as shown in Fig 2 The force is being applied for t s and after which the force is removed

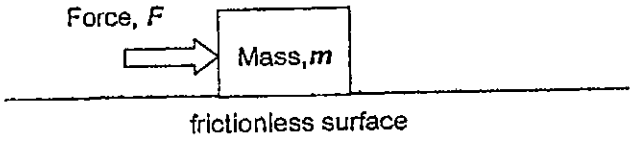
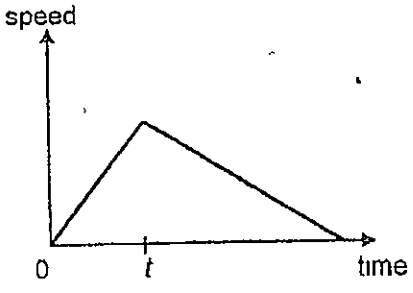


Fig 2

Which of the following speed time graphs illustrates the motion of the mass for the whole duration?

A


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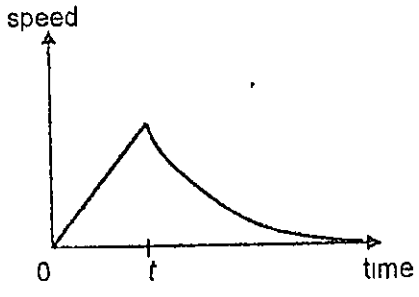
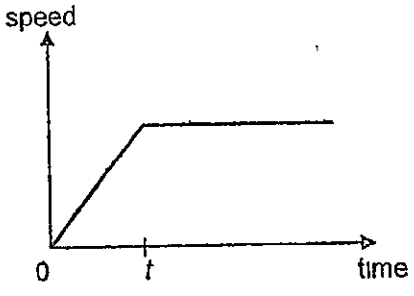
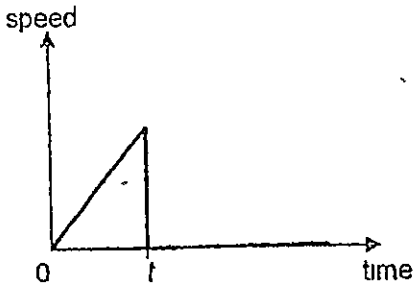


C


D


3 In the 28th SEA Games, Shanti Pereira was running at a constant rate of 5 m/s before she accelerated at a rate of 1 m/s^2 in the last 4 s of her 200 m race

What was the distance at which Shanti ran while she was accelerating?

A 8 m
B 28 m
C 50 m
D 56 m

4 A metre rule of mass 500 g is observed to balance at the 45 cm mark as shown in Fig 4a

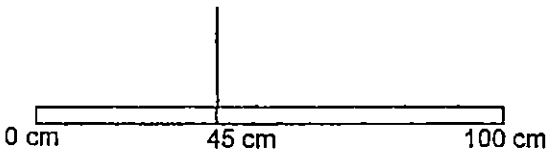


Fig 4a

The rule is then used to balance a metal ring that is being hung at the 85 cm mark as shown in Fig 4b

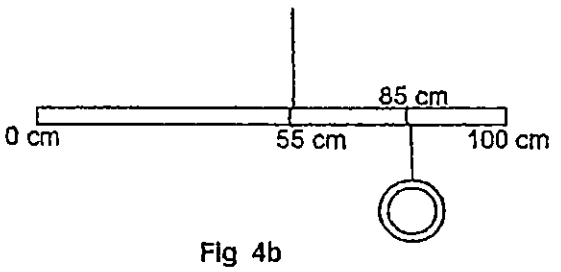
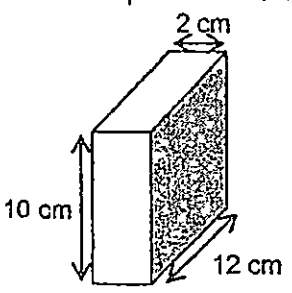


Fig 4b

What is the weight of the metal ring?

A 1 67 N
B 0 588 N
C 167 g
D 58 8 g

5 What is the greatest pressure in pascal exerted by the following block of mass 5 kg?



A 2 083 Pa
B 2 500 Pa
C 20 833 Pa
D 25 000 Pa

6 Mark is a Design & Technology student He has recently decided to work on a project to design and construct a lamp Before he carried on with the construction, he decided to do some research on previously manufactured lamps

One of the lamps that he found is as shown This lamp looks pleasing except that it has a high tendency to fall when a strong gust of wind blows

Which of the following reasons cannot be a possible reason to explain its poor stability?

A When tilted to one side, its centre of gravity falls within the base area
B The lamp's centre of gravity is located very high up due to the mass distribution
C Since the base area is small, its line of action of the weight easily acts outside this area
D It will continue to fall further due to the moment produced, away from its original position when slightly displaced

7 In Fig 7 below, a Singapore athlete was competing in the high jump event at the 28th SEA Games

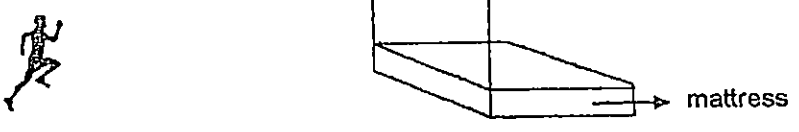


Fig 7

What was the energy conversion as he completed the jump?

A kinetic energy → thermal energy → gravitational potential energy → kinetic energy
B kinetic energy → gravitational potential energy → kinetic energy → elastic energy
C kinetic energy → elastic energy → gravitational potential energy → thermal energy
D kinetic energy → chemical energy → kinetic energy → gravitational potential energy

8 Which of the following statements describes correctly the change in the water molecules as water spilled on a table evaporates?

A Water molecules gain energy in the form of kinetic energy from an external source and break their bonding to become gaseous state.
B Water molecules gain energy in the form of potential energy from within itself and break their bonding to become gaseous state
C Water molecules gain energy in the form of kinetic energy from within itself and loosen their bonding to become gaseous state
D Water molecules gain energy in the form of potential energy from an external source and loosen their bonding to become gaseous state

9 Lixuan would like to dry her towel using a fire shown in Fig 9 below

Fig. 9

Which position should the towel be placed to receive the heat transfer by convection?

A P B Q
C R D S

10 Which of the following will not change the time taken for a beaker of water to boil in Fig 10?

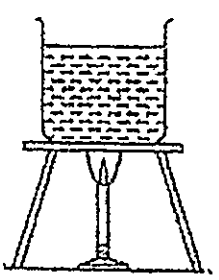


Fig. 10

A The amount of water in the beaker.
B The thickness of the beaker.
C The cross sectional area of the beaker
D The external colour of the beaker.

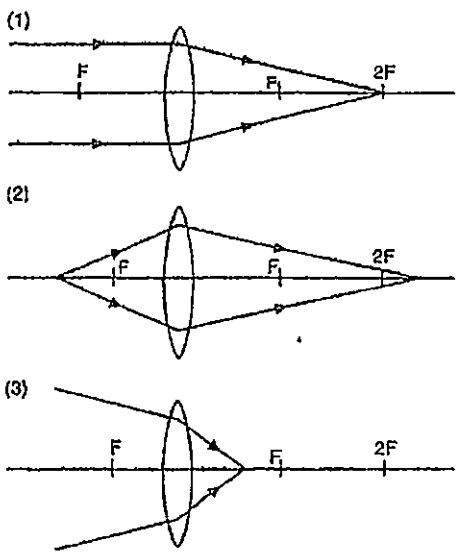
11 A ripple tank is creating a wave form with a frequency of 4 Hz as shown in Fig 11

Fig 11

Which of the following statements describes correctly how the wave form will change when the frequency of the ripple tank doubles?

A The wavelength of the wave form reduces by half
B The amplitude of the wave form doubles
C The period of the wave doubles
D The speed of the wave doubles

12 Which of the following ray diagrams correctly show(s) the paths of light rays through the lens?



A (3) only
B (1) and (3) only
C (2) and (3) only
D (1), (2) and (3)

13 Fig 13 shows a ray of light moving from diamond to air

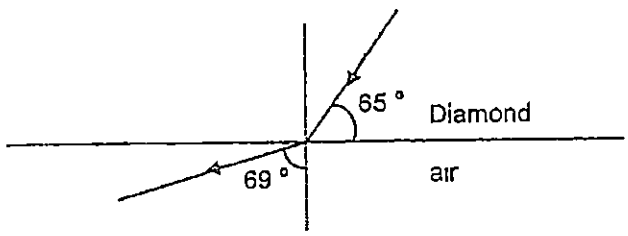


Fig. 13

What is the critical angle of diamond?

A 21 °
B 27 °
C 63 °
D 76 °

14 Which of the following lists of electromagnetic radiation is in order of increasing wavelength?

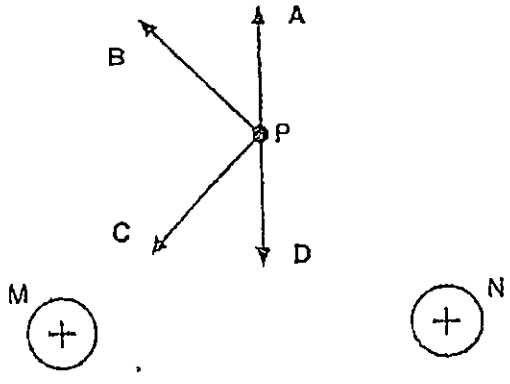
A ultra-violet, visible light, infra-red, radio waves
B infra-red, ultra-violet, visible light, radio waves
C ultra-violet, infra-red, radio waves, visible light
D infra-red, radio waves, ultra-violet, visible light

15 A geologist, investigating the position of possible oil-bearing rock, made a small explosion on the surface He then timed the return of the reflected pulse from the rock and found it to be 2 8 s Assuming the speed of sound in earth is 1800 m/s, how far below the surface is the oil-bearing rock?

A (1800 x 2 8) m
B (1800 / 2 8) m
C (1800 x 2 8 x 2) m
D [(1800 x 2 8) / 2] m

16 M and N are two spheres given the same quantity of electric charge P is a point equidistant from M and N

In which direction (A, B, C, or D) does the electric field act at the point P?



17 A 8 m long wire with a diameter of 3 mm has a resistance of 16 Ω
What is the resistance of the same type of wire which is 2 m long and has a diameter of 2 mm?

A 27 Ω
B 36 Ω
C 60 Ω
D 90 Ω

18 When connecting a washing machine to the mains, which of the following about the wires in the cable is true?

A The yellow-green wire is at high potential and is dangerous to the touch
B With the yellow-green wire disconnected, the washing machine can still operate
C The blue wire does not normally carry any current and is safe to touch
D The brown wire should be connected to the metal casing of the washing machine

19 Fig 19 shows an electric bell Which materials would be suitable for the parts labelled P, Q and R?

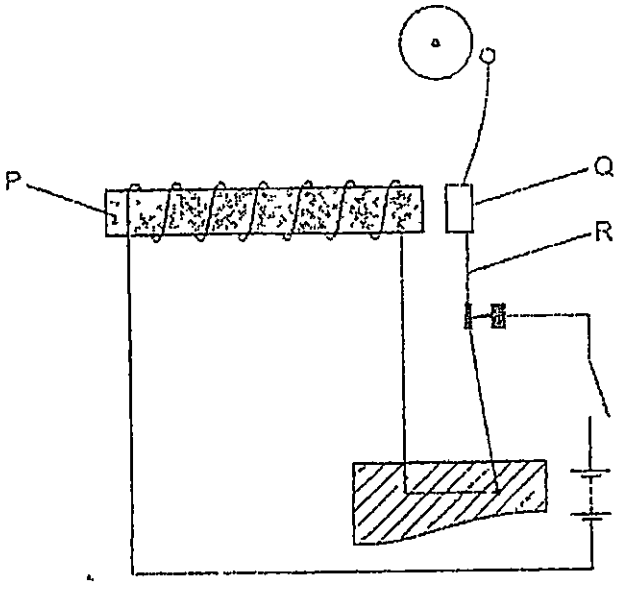


Fig. 19

	P	Q	R
A	soft iron	soft iron	spring steel
B	soft iron	brass	soft iron
C	soft iron	brass	brass
D	spring steel	soft iron	spring steel

20 Fig 20 below shows a brass rod supported on two copper rails, which are connected to a battery The north pole of a magnet is placed beneath the rails, as shown in Fig 20 In which direction does the brass rod experience a force?

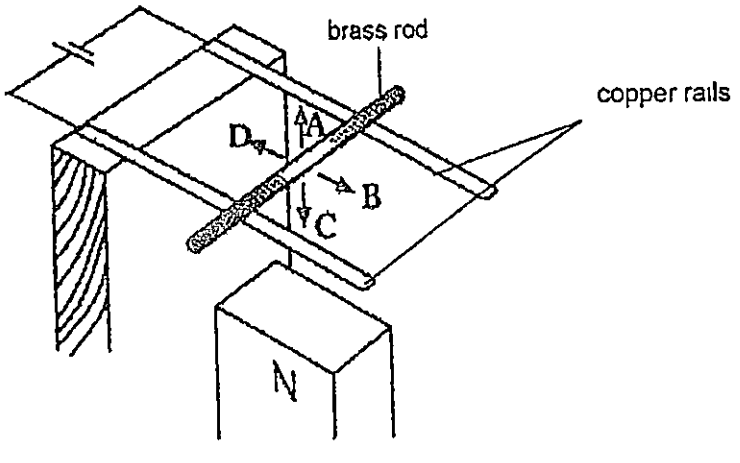


Fig. 20

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Preliminary 2 Examination 2015

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SCIENCE (PHYSICS)
FOUR NORMAL ACADEMIC/ FOUR EXPRESS/ FIVE NORMAL ACADEMIC

5076/02
1 September 2015
1 hour 15 minutes

Paper 2
Candidates answer on the Question Paper
Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer all questions
Write your answers in the spaces provided on the question paper

Section B
Answer any two questions
Write your answers in the spaces provided on the question paper

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

For Examiner's Use	
Section A	45
Section B	20
. .. .	
.. ..	
Total	65

For Examiner's Use

SECTION A [45 marks]

Answer all the questions.

Write your answers in the spaces provided on the question paper

1 Norainl was investigating balanced forces using the apparatus shown in Fig 1

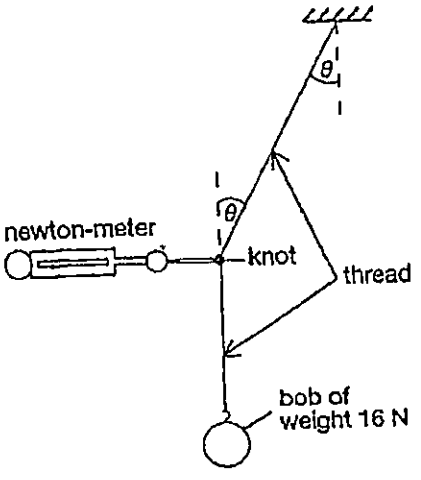


Fig 1

She noticed that θ, the angle at the upper part of the thread makes with the vertical is 45 ° when the reading on the newton-meter is 16 N

By drawing a vector diagram to scale, determine the magnitude and direction of the resultant force exerted on the knot by the bob and the newton-meter [3]

2 In the recent SEA Games there was a close race between Joseph Schooling and Quah Zheng Wen in the 200 m butterfly event

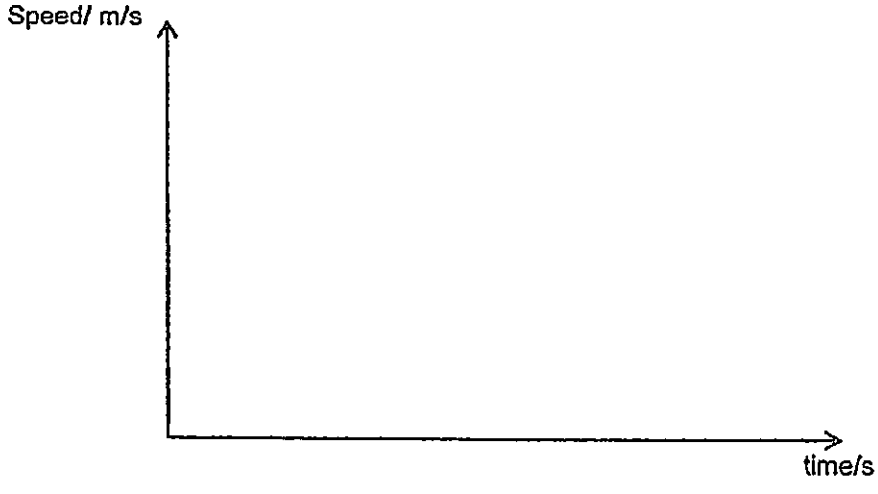
For Examiner's Use

In their last 50 m, Quah Zheng Wen was swimming at a constant rate of 2 0 m/s while Joseph Schooling who was also finishing the last 50 m accelerated at a rate of 0 1 m/s^2 from a speed of 1 5 m/s

(a) How long will Quah Zheng Wen take to complete his last 50 m? [1]

(b) How long will the Joseph Schooling take to complete the last 50 m? [3]

(c) In the speed time graph below, illustrate clearly the motion of the two swimmers for the last 50 m swim. Indicate clearly the graph for each swimmer [1]



3 A man pushes a box of mass 40 kg across the floor at a constant speed of 0 5 m/s by exerting a horizontal force of 100 N

For Examiner's Use

(a) What is the resultant force on the box? [1]

(b) What is the force of friction acting on the box? [1]

(c) Find the work done by the man in 3 s [1]

(d) Which two forms of energy is the work done by the man converted to? [2]

(e) Find the effective power produced by the man. [1]

For Examiner's Use

4 Fig 4 shows water falling over a dam

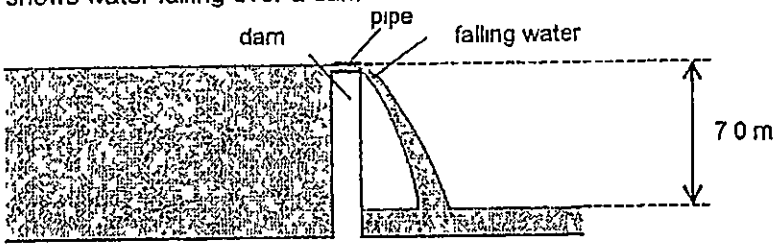


Fig 4

The vertical height that the water falls is 7 0 m and the rate of water flowing out of the pipe is 300 m^3/s Taking density of water to be 1 000 kg/m^3, calculate

(a) the potential energy of water lost during the fall in 1 s [2]

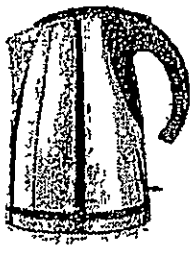
(b) Assuming all this potential energy loss is changed to kinetic energy of the water, calculate the speed of the water, in the vertical direction, at the end of the fall [2]

(c) The vertical speed of the water is less than that calculated in (b) [1]
Suggest one reason for this

For Examiner's Use

5 Consider polished shiny metallic surface of an electric kettle and the black cooling fins at the back of a refrigerator as shown in Fig 5a and Fig 5b respectively

(a) Why is the metallic surface of the kettle polished ? [1]



An electric kettle

Fig. 5a

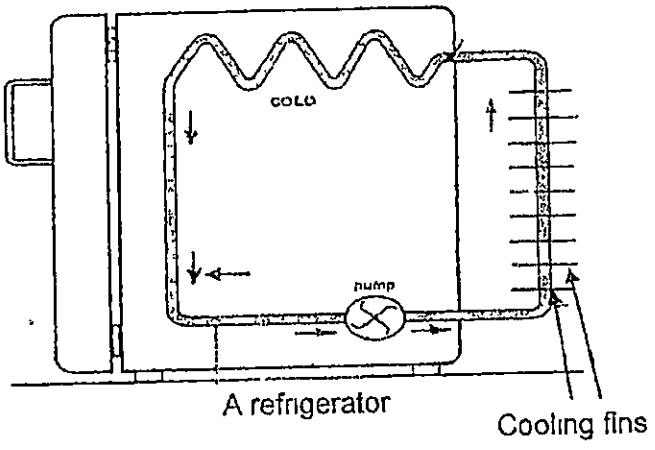


Fig 5b

(b) Why are the cooling fins of the refrigerator not shiny like the surface of kettle? [1]

. . . . . .

. . . . . .

(c) Describe one other way that the cooling fins get rid of heat quickly. [2]

. . . . . .

. . . . . .

(d) Fig. 5c shows the temperature time graph of the water at 30 °C when placed in the freezer

Sketch the temperature time graph of the water at 30 °C if the cooling fin is changed to a shiny surface [2]

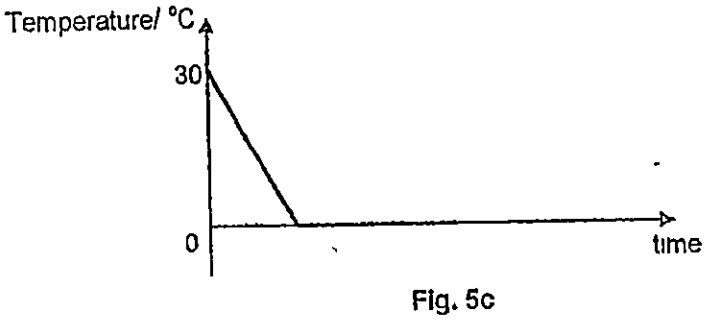


Fig. 5c

6 Fig 6a shows an incorrect electromagnetic spectrum drawn by a student The parts of the spectrum and the wavelengths are in the wrong order The values of the wavelengths do not match the correct parts of the spectrum

For Examiner's Use

short wavelength						long wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	visible
1 km	10^{-14} m	10 nm	10 μm	0 1 dm	10^{-6} m	1 nm

Fig. 6a

(a) On Fig 6b, complete the table of the electromagnetic spectrum Radio waves and its correct wavelength have been inserted for you [2]

Fig. 6b

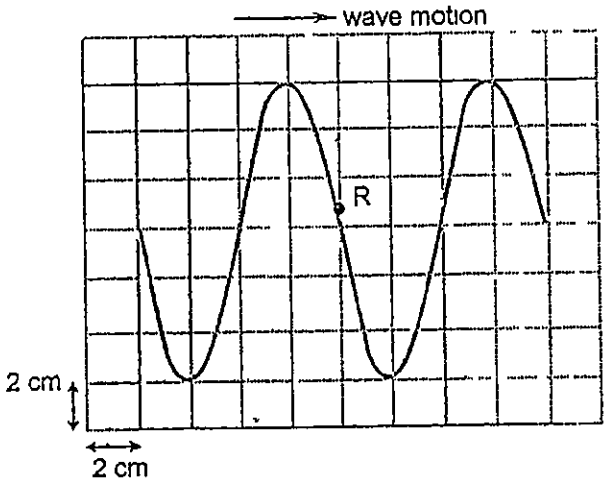
short wavelength						long wavelength
						radio waves
						1 km

(b) State the speed of X-rays in a vacuum [1]

. . . . . .

7 A transverse wave is travelling steadily from left to right through a series of particles The figure below shows the waveform on an oscilloscope

For Examiner's Use



(a) From the figure, find

(i) the amplitude, and

[1]

(ii) the wavelength of the wave

[1]

(b) It is found that the wave completes 10 oscillations in 2 s Calculate the speed of the wave [2]

(c) Describe the motion of particle R at the moment shown in the graph

[1]

For Examiner's Use

8 A piece of plastic is held in the hand and rubbed with a cloth. Both the plastic and the cloth become charged.

(a) Describe how the plastic becomes negatively-charged and the cloth becomes positively-charged. [2]

(b) Suggest why a piece of metal held in the hand does not become charged when it is rubbed with the cloth. [1]

(c) An average lightning strike transfers a charge of 4.0 C and releases as much energy as a 100 W lamp switched on for 5.0×10^6 s. There are, on average, 90 lightning strikes round the world in each second.

Calculate

(i) the energy released in an average lightning strike,

Energy = [1]

(ii) the average power released by all lightning strikes in the world in that second,

Average Power = [1]

(iii) the average electromotive force (e.m.f.) of a lightning strike.

Average e.m.f. = [2]

For Examiner's Use

9 Fig 9 shows part of a structure of a d c motor The coil of the motor, ABCD, mounted on an axle and placed between the poles of a permanent magnet

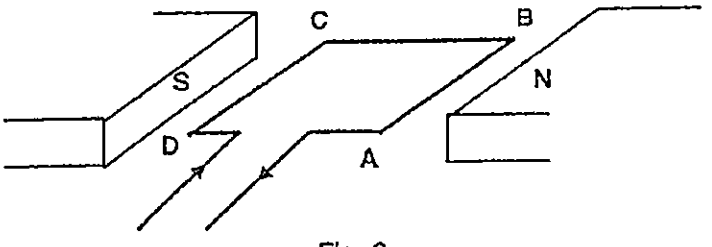


Fig. 9

(a) In which direction will the coil begin to rotate when a direct current is passed through it as shown in Fig 9? Explain why such a rotation takes place [3]

(b) State two ways in which the direction stated in (a) can be changed? [2]

Section B [20 marks]
Answer any two questions

For Examiner's Use

10 (a) A trebuchet is a war machine used to launch heavy rocks to knock down castle walls The trebuchet is made up of a heavy counterweight, a pivot, a throwing beam, and a sling

Fig 10 1 shows a trebuchet in action at two stages At stage A, the counterweight has been raised and the sling containing the rock is on the ground At stage B, the counterweight is allowed to fall and the throwing beam rotates clockwise to fling the rock into the air

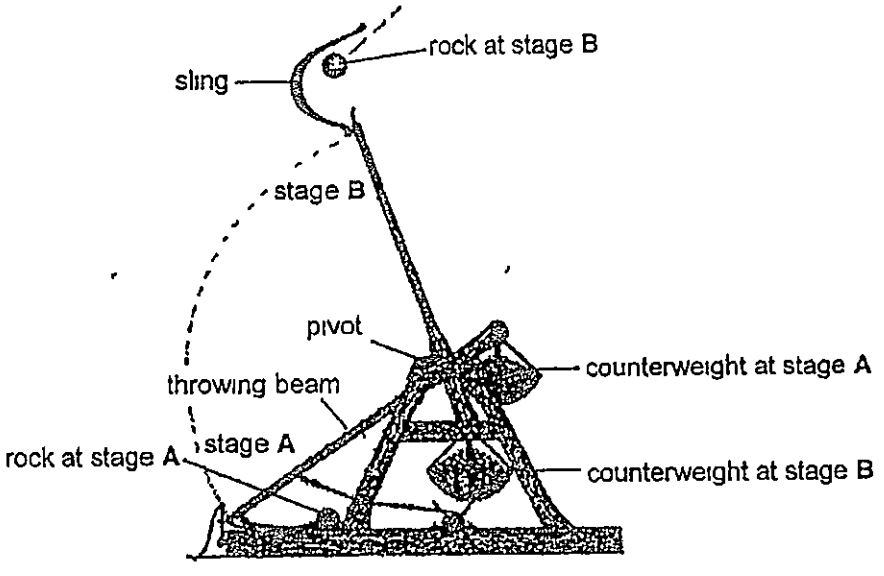


Fig. 10 1

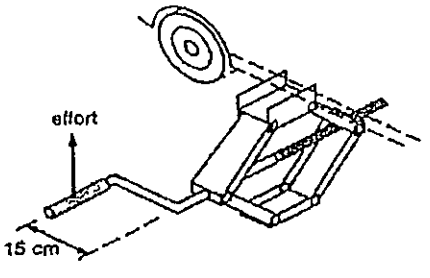
(i) State the *principle of moments* [1]

For Examiner's Use

10 (a) (II) Explain why the magnitude of the force exerted by the rock on the throwing beam is different from the force exerted by the counterweight on the throwing beam State which force is greater [4]

(III) List 2 features that are necessary on the trebuchet in order for it to be stable [1]

(b) A man uses a screw jack to lift one side of a car to replace a flat tyre The side of the car is lifted 2 5 mm on average for every revolution of the handle A force of 3500 N is required to lift the car at constant speed The handle has a turning radius of 15 0 cm and the handle needs to be turned 8 revolutions in order to change the tyre.



(I) State one advantage of using this screw jack [1]

For Examiner's Use

10 (b) When the handle has turned 8 revolutions, determine

(ii) the distance moved by the car, [1]

(iii) the distance moved by the effort, [1]

(iv) the useful energy output from the screw jack [1]

For Examiner's Use

11(a) Fig 11 1 and Fig 11 2 show rays of light passing through the same semi-circular block of plastic Q is the centre of the straight side of the block.

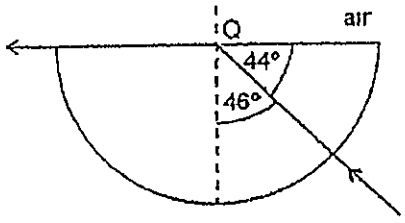


Fig 11.1

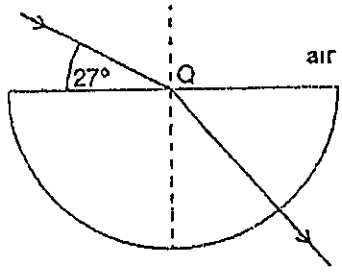


Fig 11.2

(i) State the value of the critical angle in the plastic

[1]

(ii) Explain what is meant by the critical angle

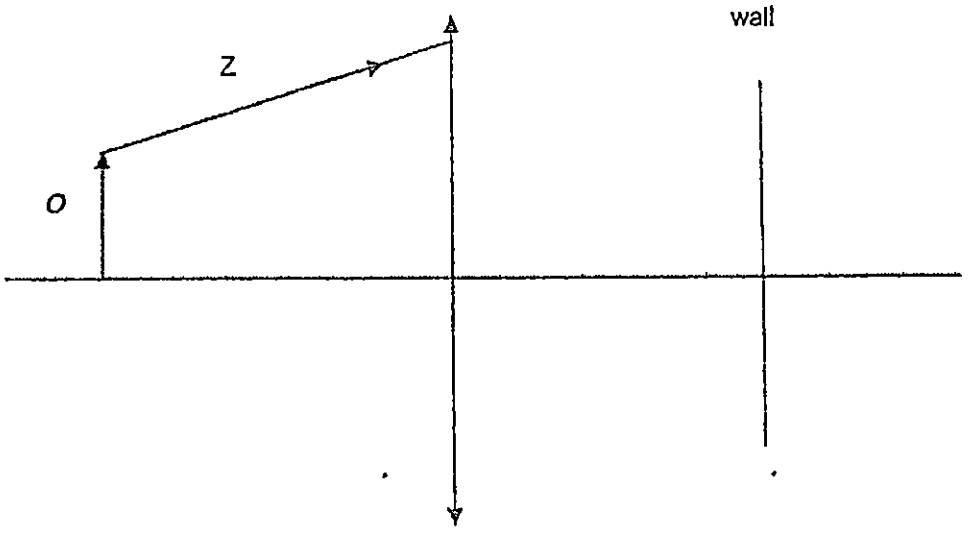
[2]

(iii) Calculate the refractive index of the plastic State the formula that you use [2]

(iv) Calculate the angle of refraction when the ray of light enters the plastic block in Fig 11 2 [2]

11 (b) An object, *O* is placed in front of a converging lens such that a sharp image is formed on the wall

For Examiner's Use



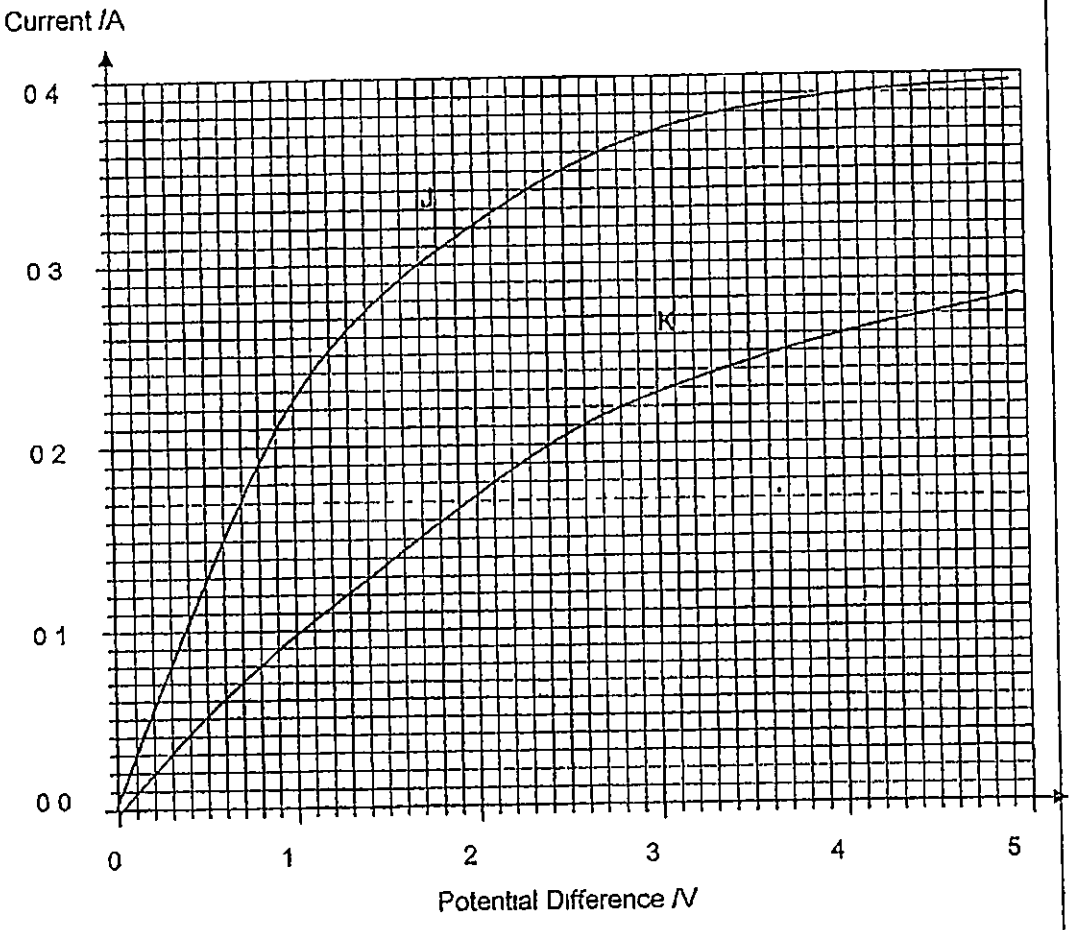
(I) Complete the ray diagram to locate the image of object and labelled it *I* [1]

(II) Denote on the diagram, F, the focal point of the lens [1]

(III) Complete the ray Z [1]

For Examiner's Use

12(a) Two light bulbs J and K are at their normal brightness when each is connected to a 4 0 V battery The graph below shows how the current varies with the potential difference for each bulb



(I) Calculate the resistance of bulb J and the resistance of bulb K when they are operating at their normal brightness [2]

12(a) (ii) The filaments of both bulbs consist of coiled tungsten wire Describe two differences between the filaments of the bulbs that would cause their difference in resistance [2]

For Examiner's Use

(iii) Fig 12 1 shows the two bulbs J and K connected between two points X and Y A 4 V battery is then connected across XY Compare the brightness of each bulb in this arrangement with its normal brightness Explain your reasoning [2]

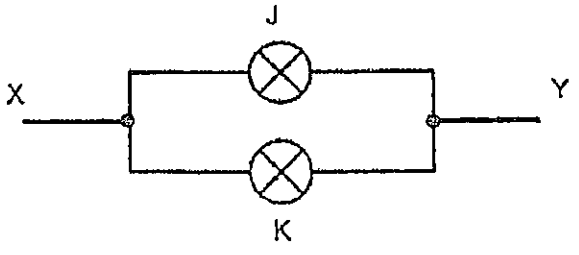


Fig 12.1

12(b) Fig 12 2 shows a circuit consisting four resistors, a battery and a lamp A lamp is connected between L and N

For Examiner's Use

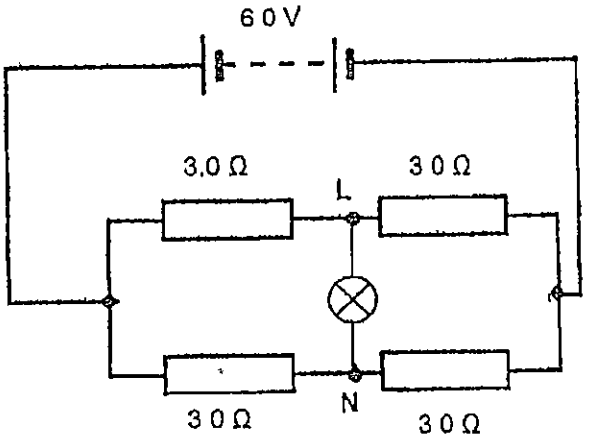


Fig 12 2

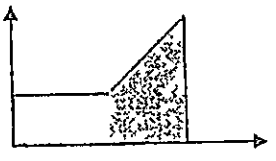
(i) State the potential difference across the lamp and hence specify whether the lamp will light up. [2]

(ii) With the bulb removed, calculate the effective resistance of the circuit shown in Fig 12 2 [2]

END OF PAPER

Answer for 2015 Sec 4Na4Ex5Na SciPhy Prelim 2 P1 Ans

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

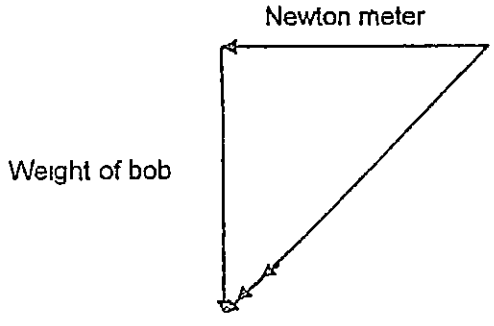
1	The volume of a liquid can't be measured using metre rule So hydrometer is used to measure density instead	D
2	A mass in motion will remain in motion unless exerted by an external force Thus the speed of the mass remains unchanged after the external force is removed	C
3	For the last 4 s, Joseph is accelerating at 1 m/s^2 from an initial speed of 5 m/s The area under the speed time graph will give 28 m 	B
4	By principle of moment, Sum of clockwise moment = Sum of anticlockwise moment 0 5 (10) (0 1) = (W) (0 3) W = 1 67 N	A
5	Greatest pressure obtained with the smallest area (2 cm by 10 cm) Pressure = Force / Area = 50 / (0 02 x 0 1) = 25 000 Pa	D
6	If the cg falls within the base area, it is stable So it is not a reason for the poor stability	A
7	The runner will change from KE to GPE to KE again as he falls and bounces on the rubber mat	B
8	Evaporation occurs without a need for external heat and the energy gain is to break the bonding thus increasing the PE of molecules	B
9	Heat transfer by convection is above the fire as hot air rises	C
10	Time taken will not change with a change in the surrounding temperature	C
11	As the frequency changes, the speed did not change and thus the wavelength will be affected	A
12	Parallel light rays will converge at focal point and not 2 x focal length An object placed between f and 2f will have its image more than 2f away	C

13	Refractive index = sin (69)/ sin (25) = 1/ sin critical angle	B
14	Longest wavelength of the EMW from Radio wave to Gamma Ray	A
15	The distance is found by using (speed x time) /2	D
16	Using electric field of the 2 charges, M and N it is found to be repelling as like charges repel Thus the electric field is heading towards A	A
17	A diameter of 2 mm has an area of 4/9 of a wire with diameter 3 mm With a 2 m long wire, the resistance drops by 4 times to become 4 Ω and with a smaller area, the resistance increases by 4/9 to get 9Ω	D
18	Yellow wire (earth) has zero potential. Without an earth wire the appliance can still operate Neutral wire does have current flowing and earth wire is connected to the metal casing not live wire	B
19	P and Q has to be soft iron to allow for easy magnetization	A
20	Using Fleming's left hand rule	B

GAN ENG SENG SCHOOL
PRELIMINARY 2 EXAM 2015
SCIENCE (PHYSICS)
FOUR NA (4B & 4C) FOUR EXPRESS (4H) AND FIVE NA (5A & 5B)
PAPER 2

Examiner's Report

1 Correct arrow direction with suitable scale [1]
Magnitude = 22 6 (+/- 1 N) [1]
Direction' 45° with weight [1]

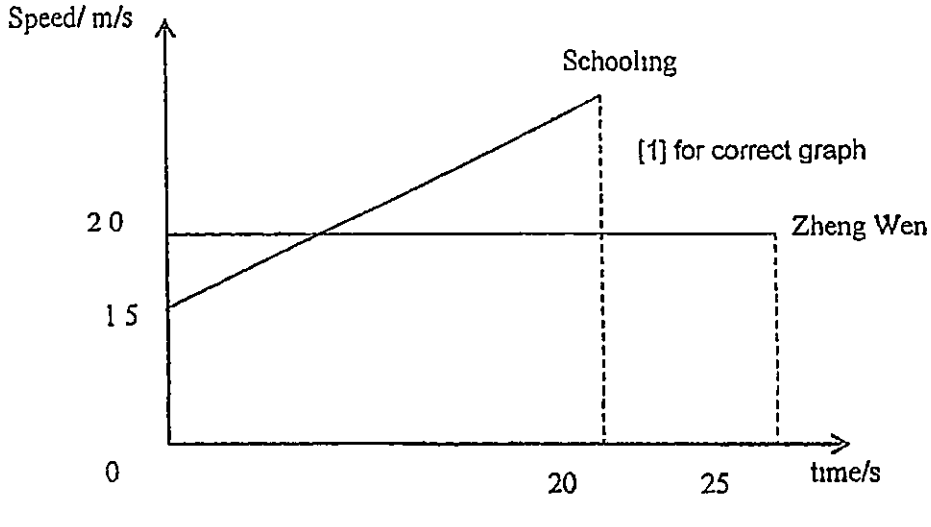


2(a) time = dist / speed = 50 / 2 = 25 s [1]

(b) a = (v – u) / t
0 1 = (v – 1 5) / t
v = 1 5 + 0 1 t [1]

Dist = area under speed time graph
50 = ½ (1 5 + 1.5 + 0 1t) (t) [1]
100 = 3.0t + 0 1 t^2
1000 = 30 t + t^2
t^2 + 30 t – 1000 = 0
(t +50) (t -20) = 0
t = 20 s [1]

(c)



1

Examiner's Report

3(a) 0 N as there's a constant speed ie zero acceleration [1]

(b) F = ma since net force is zero thus the frictional force
= 100 N [1]

(c) Work done = Force x distance = 100 x 0 5 x 3 = 150 J [1]

(d) The energy converted to are sound energy and heat [2]

(e) Power = Work Done/ time = 150 / 3 = 50 W [1]

4(a) In 1 s, the mass of water flowing out is
Mass = density x volume
= 1 000 x 300
= 300 000 kg

Therefore
PE lost = mgh
= 300 000 x 10 x 7 0 [1]
= 21000 000 J [1]

(b) KE = ½ mv^2
= 21000 000 J [1]

$v = ((70x2)/m)^{1/2}$
= 11 8 m s^{-1} [1]

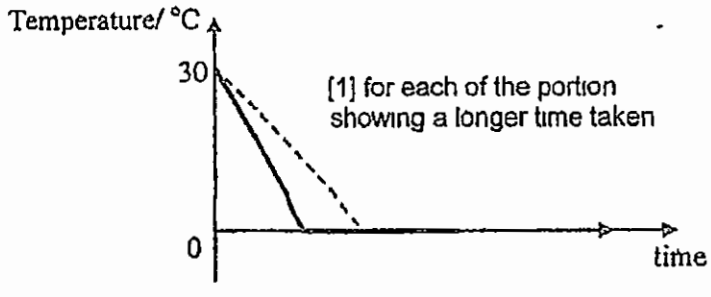
(c) Energy is lost to air resistance [1]
(or energy lost in other forms like sound/heat)

5(a) Polished surfaces are poor radiators so can keep hot water hot longer [1]

(b) Cooling fins are black because black is a better radiator of heat which is needed to transfer the heat out easily so as to keep the contents of fridge cool [1]

(c) Cooling fins increase surface area [1]
so that the heat can radiate faster [1]

(d)



[1] for each of the portion showing a longer time taken

6(a) [1] for correct order of waves
[1] for correct order of magnitude

Gamma	x-ray	Ultra-violet	Visible	Infra-red	Microwave	Radiowave
10^{-14} m	1 nm	10 nm	10^{-6} m	10 μm	0 1 dm	1 km

(b) 3×10^8 m s^{-1} [1]

7 (a) i) Amplitude = 6 cm [1]

ii) $\lambda = 8$ cm [1]

(b) $f = 10 / 2 = 5$ Hz [1]
$v = f\lambda = 5 \times 8 = 40$ cm/s [1]

(c) R is moving vertically upwards [1]

8 (a) Electrons from the cloth are transferred to the plastic by friction [1]
such that the plastic has excess negative charges, hence it is negatively charged while the cloth has shortage of electrons, hence it is positively charged [1]

(b) The electrons are able to move freely and flow down to earth as earthing takes place through the hand [1]

(c) (i) $E = P \times t$
$= 100 \times 5\ 0 \times 10^6$
$= 5\ 0 \times 10^8$ J [1]

(ii) Average power = $(5\ 0 \times 10^8 \times 90)/1$
$= 4\ 5 \times 10^{10}$ W [1]

(iii) E m f. = W/Q
$= 5 \times 10^8 / 4$ [1]
$= 1\ 25 \times 10^8$ V [1]

9 (a) Clockwise direction [1]

When a current is flowing through side CD of coil, there's a induced magnetic field induced by the current such that there's an reinforcing effect below the side CD while a cancel out effect above side CD due to the interaction of magnetic field of the magnet and the current [1]

This effects create a resultant force upwards in side CD and vice versa on the side AB thus creating a clockwise moment for the coil ABCD [1]

Examiner's Report

(b) Reverse the direction of current flowing [1]
Reverse the polarity of the magnetic polarity used [1]
[choice of words used ie "reverse" is important
Not allow the use of 'change' as Cambridge
do not allow]

10 (a) (i) For an object at equilibrium, the clockwise moments about a pivot must be equal to the anti-clockwise moments about the same pivot [1]

(ii) As the throwing beam must rotate clockwise to launch the rock, the clockwise moments exerted by the counterweight must be greater than the anti-clockise moments exerted by the rock. [1]
The perpendicular distance from the counterweight to the pivot is smaller than the perpendicular distance from the rock to the pivot [1]
Since moments = force x perpendicular distance between the force and the pivot, [1]
the force exerted by the counterweight on the throwing beam must be greater than the force exerted by the rock on the throwing beam [1]

(iii) Large base area and a low c.g [1]

(b) (i) The screw jack is used to magnify force so that the output force is much larger than the input force [1]

(ii) Distance moved by the car = $8(2\ 5 \times 10^{-3}) = 0\ 02$ m [1]

(iii) Distance moved by the effort = 8(circumference) = $8(2\pi r)$
$= 8(2\pi)(0\ 15) = 7\ 5$m [1]

(iv) Useful energy output = Force x distance moved by the car
= 3500 x 0.02
= 70 J [1]

Examiner's Report

Examiner's Report

11(a)(i) 46°[1]

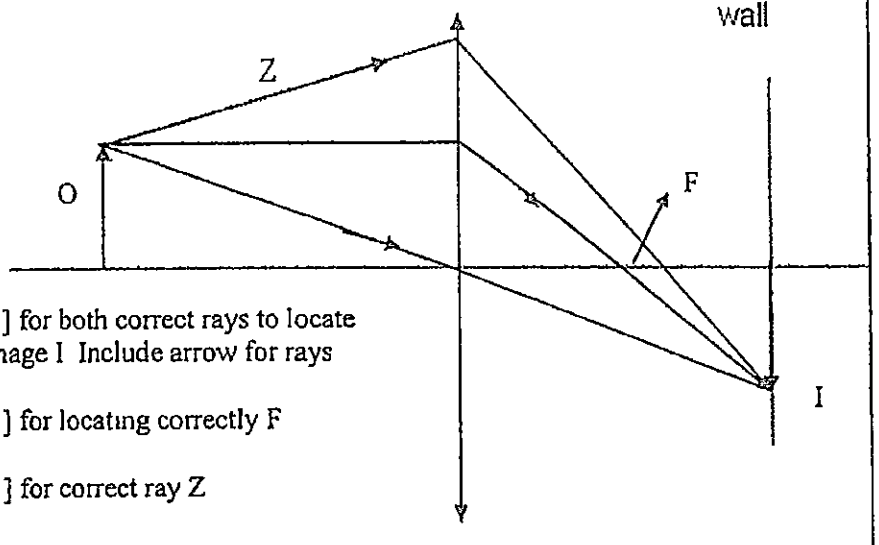
(ii) Critical angle is the <u>angle of incidence</u> in the <u>optically denser medium</u>[1]
when a ray passes from a <u>optically denser</u> to a <u>less optically denser</u> medium with angle of <u>refraction as 90°</u>[1]

(iii) $\eta = \frac{1}{\sin c} = \frac{1}{\sin 46°}$ [1]
= 1 39 [1]

(iv) $r = \sin^{-1}\left(\frac{\sin i}{\eta}\right) = \sin^{-1}\left(\frac{\sin 63°}{1\ 39}\right)$ [1]
= 39 9°[1]

11

(b)



[1] for both correct rays to locate image I Include arrow for rays

[1] for locating correctly F

[1] for correct ray Z

12ai Resistance of J = V/I = 4/0 39 = 10 3 Ω [1]
Resistance of K = V/I = 4/0 26 =15 4Ω [1]

12aii Filament of bulb K is longer [1] and has a smaller cross-sectional area [1]

12aiii The two bulbs are in connected in parallel and the <u>potential difference of 4V is the same across each bulb [1]</u>
Hence both bulbs are at their normal brightness. [1]

12bi Potential difference across lamp is 0V [1], hence lamp will not light up [1]

12bii Total resistance = $(1/6 + 1/6)^{-1}$ [1]
= 3 Ω [1]