Part I : Each multiple choice Questions (A, B, C, D, E) is worth 2 points. (Total 30 points.)

1. A vernier caliper has a least count of 0.1 mm. Which measurements below could reasonably have been recorded using this instrument?

Object	Length
F	41.7 cm
G	12.51 mm
H	10.00 cm
I	82.5 mm
J	400.010 cm

A. F, H, and J
B. G and I
C. H and I
D. G and H
E. J only

2. Why is the light-facing surface of a solar cell usually dark and treated with an anti-reflective coating?

A. To absorb more incoming light and reduce reflection
B. To prevent the cell from producing electrical current
C. To reflect most visible light back into the environment
D. To increase its temperature without absorbing light
E. To prevent sunlight from reaching the semiconductor

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3. Which group is well known to include hyperthermophilic organisms capable of growing at temperatures above 100°C ?

A. Fungi
B. Archaea
C. Animals
D. Plants
E. Protozoa

4. Which group consists entirely of arthropods?

A. Jellyfish, coral, and sea star
B. Sea anemone, coral, and sea snake
C. Bird, fish, and frog
D. Bee, mosquito, and roundworm
E. Spider, crab, and millipede

5. Grass ⟶ Grasshopper ⟶ Bluebird ⟶ Snake ⟶ Owl

Fungi

Based on the food chain illustrated above, If the bluebird population decreases substantially, which change is most likely to occur first?

A. The grasshopper population increases.
B. The snake population increases.
C. The owl population increases.
D. The grass population increases immediately.
E. All populations remain unchanged.

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6. A glass contains liquid water and a piece of ice floating freely on the surface. Assume that no water evaporates or spills from the glass.

As the ice melts completely, what happens to the water level in the glass?

A. The water level gradually increases as the ice melts.

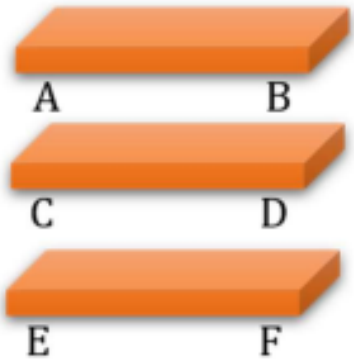
B. The water level gradually decreases as the ice melts.

C. The water level remains unchanged throughout the melting process.

D. The water level increases at first and then gradually decreases.

E. The water level decreases at first and then gradually increases.

7. Three bar magnets, each end is marked with the letters A to F. From several experiments it is known that:



✓ A and C repel each other

✓ B and E also repel each other

✓ F is a magnetic north pole

The correct conclusion from the experiments is:

A. A and C are magnetic south poles

B. D and E are magnetic south poles

C. B and E are magnetic north poles

D. B and D are magnetic north poles

E. C and E are magnetic south poles

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8. If the average Earth–Moon distance became twice its present value while the Moon retained approximately the same size, which observation would be most likely?

A. All solar eclipses would become more frequent.

B. Lunar eclipses would become impossible.

C. Full moons would no longer occur.

D. Total solar eclipses would no longer occur.

E. The Moon would appear larger from Earth.

9. Which part of the eye helps us to see in dim light?

A. cone cells

B. iris

C. cornea

D. lens

E. rod cells

10. In physics, mass is measured in kilograms, whereas weight is a force measured in newtons. Suppose an object is moved from Earth to another planet where the gravitational field strength is different. Assume that no material is added to or removed from the object.

Which statement correctly describes what happens to the object's mass and weight?

A. Both its mass and weight remain unchanged because neither quantity depends on gravity.

B. Its mass remains unchanged, but its weight changes because weight depends on gravitational field strength.

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C. Its weight remains unchanged, but its mass changes because mass depends on gravitational field strength.

D. Both its mass and weight change because gravitational field strength affects both quantities in the same way.

E. Its mass increases while its weight decreases because weaker gravity causes the object to contain more matter.

11. Pure water boils at 100°C under standard atmospheric pressure. However, its boiling point can change when the external pressure changes.

Which statement correctly describes the relationship between external pressure and the boiling point of water?

A. A higher external pressure raises the boiling point, while a lower external pressure lowers it.

B. A higher external pressure lowers the boiling point, while a lower external pressure raises it.

C. Pure water always boils at exactly 100°C, regardless of the external pressure.

D. Higher air humidity raises the boiling point, while external pressure has no significant effect.

E. Higher air humidity lowers the boiling point, while external pressure has no significant effect.

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12. Five different foods labelled A, B, C, D, and E were tested for glucose, starch, and protein. The color of the solutions after the tests are shown in the following table.

Solution	Color after testing for glucose	Color after testing for starch	Color after testing for protein
A	blue	orange	purple
B	brick-red	blue-black	purple
C	green	orange	blue
D	brick-red	orange	blue
E	blue	blue-black	blue

Which food solution contains high concentration of glucose but not starch and protein?

A. A
B. B
C. C
D. D
E. E

13. During a school visit to a museum, a student observes a large pendulum swinging back and forth in an old clock. Assume that the pendulum remains at the same location and oscillates with a small amplitude.

Which of the following quantities determines the time taken for the pendulum to swing from one extreme position to the opposite extreme position?

A. The mass of the pendulum bob
B. The length of the pendulum
C. Both the mass and the length of the pendulum
D. The material of the pendulum bob
E. The humidity of the surrounding air

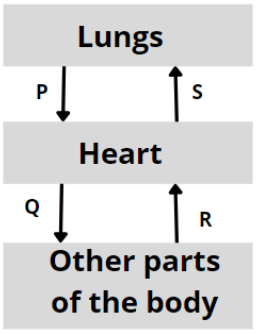
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14. A student is asked to draw a simplified diagram of the human circulatory system. The arrows show the direction of blood flow, and the letters P, Q, R, and S represent different points along the circulation. The following information is given:

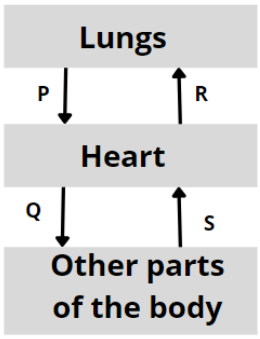
- Blood at **P** has a lower carbon dioxide concentration than blood at **R**.
- Blood at **S** has a lower carbon dioxide concentration than blood at **P, Q, and R**.
- Blood at **Q** has a higher carbon dioxide concentration than blood at **P, R, and S**.

Which of the following diagrams best represents the correct pattern of blood flow?

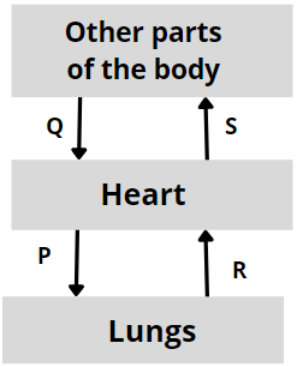
A.



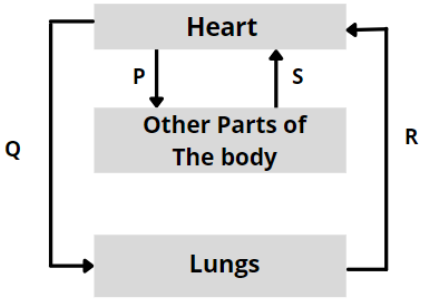
B.



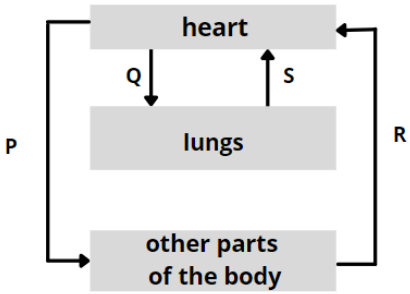
C.



D.

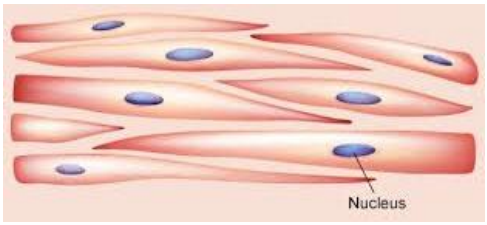


E.



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15. The following picture shows structure of a muscle in human body.



What organs that have the above muscle structure?

1. heart
2. Stomach
3. Intestine
4. Biceps
5. Triceps
6. blood vessels

A. 1, 2, 3
B. 1, 3, 5
C. 2, 4, 5
D. 2, 3, 6
E. 4, 5, 6

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Part II : Each short answer is worth 3 points. (Total 30 points.)

16. If we drop two plates of the same size, one made of paper and one of copper, which one reaches the floor first, and why?

17. If we rub plastic into our hair and hold it close to small pieces of paper, what will happen to these pieces of paper? Note that the plastic acquires negative charges in the rubbing process

18. Type of vitamin that prevents scurvy is _____.

19. There are 3 iron rods, namely 1, 2 and 3. It is known that rod 1 is a magnet with ends A and B. Rod 2 has ends C and D, and rod 3 has ends E and F. End A is known to be the north pole. The following results are obtained from an experiment: the ends A and C attract, the ends A and F repel, and the ends D and F attract. From this experiment it can be concluded that the rod ____19.1____ is ordinary iron (not magnetized), and the other rod is a magnet with the end ____19.2____ is the north pole and the end ___19.3____ is the south pole.

20. Pair the correct leaf types and plants!

Leaf Types	Plant
Parallel	Rose
Pinnate	Grass
Palmate	Papaya

20.1 parallel - .....

20.2 pinnate - .....

20.3 palmate - .....

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21. A person cannot see clearly at a distance of more than 2 meters. To correct this condition, he use a pair of glasses that are made of ___21.1___lenses with focal lengths of ___21.2___ meters.

22. A piece of iron and a feather are released from rest at the same time from the same height above the surface of the Moon. Because the Moon has essentially no atmosphere, air resistance can be neglected.
The time taken for the iron to reach the Moon's surface is___22.1___ the time taken for the feather to reach the surface. The same piece of iron is then released from rest from the same height above the surface of the Earth. Neglect air resistance acting on the iron object. The time taken for the iron to reach the Earth's surface is ___22.2___ the time taken for the same iron object to reach the Moon's surface.

23. Galileo used a telescope to confirm the heliocentric model, which state that ___23.1___ is the center of the solar system. He observed that the planet Venus sometimes appears in ___23.2___ phase, while in the geocentric model the planet Venus can only appear in ___23.3___ Phase

24. Abdul, Benny, and Caca give consecutively 3 N, 4 N, and 5 N Force. If all the forces act at one object, the maximum resultant force is ___24.1___ N and the minimum resultant force is ___24.2___ N

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25. Because Earth's axis is tilted, the location where the Sun's rays strike Earth most directly appears to migrate north and south during the year. This is known as the apparent annual north–south migration of the Sun's direct rays.

During October, after the September equinox, the position of the Sun's direct rays moves southward from the Equator toward ___25.1___. During this period, the Northern Hemisphere is experiencing ___25.2___, while the Southern Hemisphere is experiencing ___25.3___.

Part III : Essay (Total 40 points.)

26. A bat detects small objects by emitting high-frequency sound waves and receiving the reflected echoes. For this problem, assume that the smallest object the bat can detect has a size approximately equal to the wavelength of the sound reaching the object. The bat emits sound at a frequency of 50.0 kHz. The speed of sound in air is 340 m/s.

26.1 What is the term used for sound with a frequency of 50.0 kHz? (2 points)

26.2 When the bat is stationary relative to the air, what is the approximate minimum size of an object that it can detect? (2 points)

26.3 The bat now flies directly toward a stationary object at 40 m/s while continuing to emit sound at 50.0 kHz. Assume there is no wind. What is the approximate minimum size of an object that it can detect in front of it? (2 points)

27. A hollow glass bottle has an external volume of 500 ml, including an internal cavity of 400 ml. The bottle is placed upright in a liquid of unknown density and floats without allowing the surrounding liquid to enter the bottle.
When the bottle is empty, it displaces 300 ml of the liquid. Next, 45 ml of water is poured into the bottle. The bottle still floats upright and now displaces 350 ml of the liquid. The density of water is 1.00 g/ml.

27.1 Determine the density of the surrounding liquid in g/ml. (2 points)

27.2 Determine the density of the glass from which the bottle is made in g/ml. (2 points)

27.3 What minimum volume of water must be added to the initially empty bottle for the bottle to be just fully submerged, assuming that no surrounding liquid enters the bottle? (2 points)

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28. A traveler drives from Town A to Town B along the same straight road.
On the outward journey from A to B, he travels exactly half of the total distance at 40 km/hand the remaining half at 60 km/h.

28.1 Determine his average speed for the journey from A to B.

On the return journey from B to A, he travels at 40 km/h for exactly half of the total travel time and at 60 km/h for the other half. (2 points)

28.2 Determine his average speed for the return journey. (2 points)

28.3 The point where he changes speed on the outward journey and the point where he changes speed on the return journey are 20 km apart. Determine the distance between Town A and Town B. (2 points)

29. A helicopter carrying relief supplies hovers motionless at a height of 100 m above the ground. The total mass of the helicopter, passengers, and supplies is 2000 kg Take the gravitational field strength to be g = 10 m/s^2 and take the ground as the zero level of gravitational potential energy.

29.1 What is the total mechanical energy of the helicopter while it is hovering at this height? (4 points)

29.2 What upward lifting force is required to keep the helicopter hovering at a constant altitude? (4 points)

29.3 While the helicopter remains stationary at this altitude, what is the mechanical work done by the lifting force on the helicopter? (4 points)

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30. A container is filled with seawater. An object is placed in the seawater and becomes completely submerged and suspended at rest in the middle of the liquid without touching the sides or bottom of the container. Thus, initially, the buoyant force on the object is equal to its weight. Assume that the volume and density of the object remain unchanged throughout the following experiments.

30.1 Fresh water is gradually added to the container and is allowed to mix uniformly with the seawater. What will happen to the object? Explain your answer in terms of liquid density and buoyant force. (3 points)

30.2 Instead of adding fresh water, the original seawater is heated until its temperature increases significantly. Assume that:

- no water evaporates;
- the temperature range is such that the density of the seawater decreases as its temperature increases; and
- thermal expansion of the object is negligible.

What will happen to the object? Explain your answer. (3 points)

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National Selection : ASMOPSS Thailand 2023 (2nd Round – Science Primary)

Answer Key :

Part I : Each multiple choice Question (A, B, C, D, E) is worth 2 points.

No.	Answers	No.	Answers	No.	Answers
1.	B	6.	C	11.	A
2.	A	7.	B	12.	D
3.	B	8.	D	13.	B
4.	E	9.	E	14.	E
5.	A	10.	B	15.	D

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Part II : Each short answer is worth 3 points. (Total 30 points.)

No.	Answers
16.	The copper plate reaches the floor first because air resistance has a much greater effect relative to the weight of the lighter paper plate.
17.	The paper pieces are attracted to the negatively charged plastic because charges within the paper become polarized.
18.	Vitamin C (ascorbic acid)
19.	19.1 Rod 2 = ordinary iron 19.2 F = north pole 19.3 E = south pole
20.	20.1 Parallel — Grass 20.2 Pinnate — Rose 20.3 Palmate — Papaya
21.	21.1 negative/concave/diverging lens 21.2 –2.0
22.	22.1 equal to 22.2 less than
23.	23.1 Sun 23.2 full or gibbous 23.3 crescent
24.	24.1 12 N 24.2 0 N
25.	25.1 South/Southern hemisphere/tropic of Capricorn; 25.2 Autumn (fall) 25.3 Spring

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Part III : Essay (Total 40 points.)

No.	Answers
26.	26.1 Ultrasonic sound / Ultrasound 26.2 $$\lambda = \frac{\mathrm{v}}{\mathrm{f}} = \frac{340}{50{,}000} = 6.8 \times 10^{-3}\ \mathrm{m}$$ $$= 6.8\ \mathrm{mm}$$ 26.3 For a sound source moving toward the object, successive wavefronts in front of the source are closer together: $$\lambda' = \frac{v - v_s}{f}$$ $$\lambda' = \frac{340 - 40}{50{,}000} = 6.0 \times 10^{-3}\ \mathrm{m}$$ $$= 6.8\ \mathrm{mm}$$
27.	27.1 Density of the surrounding liquid Adding 45 ml water increases the mass by $$45\ \mathrm{g}$$ and increases the displaced volume by $$350 - 300 = 50\ \mathrm{ml}$$ For a floating object, $$\text{additional weight} = \text{additional buoyant force}$$ Therefore, $$\rho\ (50) = 45$$ $$\rho = 0.90\ \mathrm{g/ml}$$

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27.2 Density of the glass

For the empty floating bottle,

$$m_{bottle} = (0.90).(3.00) = 270 \text{ g}$$

The actual volume of glass is

$$500 - 400 = 100 \text{ ml}$$

Therefore,

$$\rho_{glass} = \frac{270}{100}$$

$$\rho_{glass} = 2.70 \text{ g/ ml}$$

27.3 Water required for just full submersion

When the bottle is just fully submerged, it displaces its entire external volume:

$$V = 500 \text{ ml}$$

The maximum buoyant force corresponds to a displaced-liquid mass of

$$(0.90)(500) = 450 \text{ g}$$

The empty bottle has a mass of 270 g, so the required additional mass of water is

$$450 - 270 = 180 \text{ g}$$

Since water has a density of 100 g/mL,

$$180 \text{ ml}$$

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28.

28.1 Equal distances

Let each half-distance be d.

$$v_{avg} = \frac{2d}{\frac{d}{40} + \frac{d}{60}}$$

$$= \frac{2}{\frac{1}{40} + \frac{1}{60}}$$

$$= 48 \text{ km/h}$$

28.2 Equal times

Let the traveler spend time t at each speed.

$$v_{avg} = \frac{40t + 60t}{2t}$$

$$= 50 \text{ km/h}$$

28.3 Distance between the towns

Let the distance from A to B be D.

The speed-change point on the outward journey is

$$\frac{D}{2} = 0.50D$$

On the return journey, because equal times are spent at 40 and 60 km/h,

$$D = 40t + 60t = 100t$$

One segment therefore has length 40t = 0.40 D, while the other has length 60t = 0.60 D. Thus the return speed-change point is 0.10 D away from the midpoint. Given that this separation is 20 km,

0.10 D = 20

D = 200 km

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29.

29.1 Mechanical energy

Since the helicopter is stationary, K = 0

Therefore,

$$E = U = mgh$$
$$= (2000)(10)(100)$$
$$= 2.0 \times 10^6$$

29.2 Lifting force

Because the helicopter is hovering,

$$\Sigma F = 0$$

Therefore,

$$F_{lift} = mg$$
$$= (2000)(10)$$
$$= 20{,}000 \text{ N}$$

29.3 Mechanical work done on the helicopter

Mechanical work is

$$W = Fs \cos \theta$$

Since the helicopter does not change position,

$$S = 0$$

Therefore,

$$W = 0J$$

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30.

30.1 Adding fresh water

Initially, the object is suspended at rest, so

$$F_B = W$$

and therefore its average density is equal to that of the original seawater.

Adding fresh water and allowing it to mix with the seawater decreases the density of the surrounding liquid.

The buoyant force is

$$F_B = \rho_{liquid} V g$$

Since ρ_{liquid} decreases while the object's submerged volume remains the same,

$$F_B \downarrow$$

Eventually,

$$F_B < W$$

so the object moves downward.

The object sinks

30.2 Heating the seawater

Under the stated conditions, heating causes the seawater to expand and its density to decrease.

Again,

$$F_B = \rho_{liquid} V g$$

A decrease in seawater density causes the buoyant force to decrease.

Because the object's weight remains unchanged,

$$F_B < W$$

and the object begins to move downward.

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